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MAIN CONTENTS OF THIS ISSUE

WELD-METAL PROPERTIES

Thermal Influences—How They Affect the Weld Metal (Ronay) 17

FLAME CUTTING

Flame Cutting—I (Ross) 20

MANGANESE STEEL

Welding 11-14%-Manganese Steel (Payne) 24

WATERCRAFT

Advantages of Steel Hulls in River and Harbor Craft (Sykes) 27
Arc-Welded Construction Increases Capacity of Freighters (Davis) 29

REINFORCED CONCRETE

Welded Reinforcements for Concrete Structures (Bondy) 34

Editorial 15
Welding Research Program Under Way 19
Controlling Distortion in Welding and Cutting Job 22
A.S.T.M. Holds 40th Annual Meeting in New York 23
Forms Automotive Council of American Welding Society 23
Naval Architects Discuss Arc-Welded Construction 26
Job Shop Repairs 31,000-Lb. Sugar-Refinery Roll 26
Coming Events 23
Tentative Specifications for Filler Metal. 28
How to Prevent Fires Due to Welding and Cutting 28
Welded Design Features New-Type Concrete Bucket 32
Welding News in Pictures 33
Assembling Steel-Plate Work for Welding 38
Metal Spraying of Dredge Parts 38
Deluxe Towboats of Welded Construction 38
Ohio Welding Shops Get Newspaper Publicity 39
Get "H. O. T." on Welding 40
New Products 41
Trade Literature 44
Commercial News 44
Notes From the Field 47

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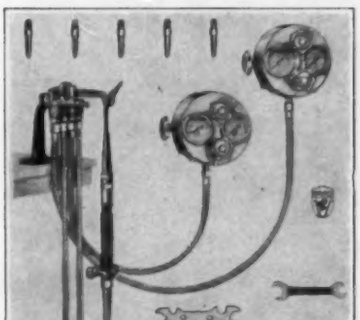

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INDEX TO ADVERTISERS

	Page
A	
Adams Co., J. D.	59
Air Reduction Sales Co.	14
Aladdin Rod & Flux Mfg. Co.	56
American Agile Corp.	55
American Brass Co.	43
American Steel & Wire Co.	16
American Welding Society	45
Anti-Borax Compound Co.	56
Arcos Corp.	57
B	
Bastian-Blessing Co., The	6
C	
Central Steel & Wire Co.	Inside Back Cover
Chicago Hardware Foundry Co.	54
Chicago Steel & Wire Co.	54
Churchward Engineering Co., Inc.	Back Cover
Classified Ads	51
Colmonoy, Inc.	49
Commercial Acetylene Supply Co., Inc.	53
E	
Eisler Engineering Co.	56
F	
F. R. Faulk	58
G	
General Electric Co.	9
H	
Harnischfeger Corporation	13
Hercules Products Co.	51
Hobart Brothers	3
Hotel Carter	54
I	
Ideal Electric & Mfg. Co.	54
Ideal Face Shield Co.	53
J	
Jackson Electrode Holder Co.	Inside Front Cover, Inside Back Cover
L	
Lincoln Electric Co., The	7 and 51
M	
Metal & Thermit Corp.	8
Metal-Bond Mfg. Co.	58
Milburn Co., The Alexander	58
N	
National Carbide Corp.	53
New Process Plow Welding Co.	51
O	
Okonite Co., The	48
P	
Page Steel & Wire Co.	12
Pierce Governor Co.	55
R	
Revere Copper & Brass, Inc.	52
Roebling's Sons Co., J. A.	4
Ryerson & Sons, Inc., Jos. T.	46
S	
Sabin Company Gloves	56
Safety Gas Lighter Co.	57
Shawinigan Products Corp.	56
Shoot-A-Light Corporation	58
Smith & Co., Inc., Gordon	55
Steel Sales Corp.	53
Stoody Co.	52
Stulz-Sickles Co.	57
T	
Titan Metal Mfg. Co.	47
Torchweld Equipment Co.	53
Torit Mfg. Co.	58
U	
U. S. Steel Corp. Subsidiaries	16
V	
Victor Equipment Co.	10
W	
Westinghouse Electric & Mfg. Co.	11
Wilco Co.	58
Wooldridge Aluminum Welding Products	58

The Welding Engineer

VOLUME XXII JULY, 1937 NUMBER 7

Thermal Influences—

How They Affect the Weld Metal . . .

■ By BELA RONAY
Senior Welding Engineer, U. S. Naval Engineering Experiment Station, Baltimore

WHY does the multi-pass weld have better physical properties than the single-bead weld? To what temperature should the weld cool before subsequent passes are made? In a multi-pass weld, what is the thickness of layer that should not be exceeded? These and other questions are answered here by Mr. Ronay, who shows how the welder can demonstrate these facts for himself.

WELDING electrodes are comparable in some respects to well-bred horses. Both respond to handling and their performance is a major function of the treatment or usage to which they are subjected. Favorites with a hard-earned reputation fail sometimes to come into place when conditions or the handling are not in accordance with the particular requirements of the steed. Likewise, most statements concerning the physical properties of the weld metal deposited from a specified brand of welding electrodes — that is, the tensile strength, yield point, ductility, impact value, and endurance limit—are given in good faith and may be correct, provided certain conditions are maintained in course and subsequent to the deposition of the electrodes.

Cast Weld Metal Is Improved by Heat-Treatment

Since the weld metal deposited from welding electrodes is a casting, it is evident that it must be subjected to heat-treatment similar to that required to develop the desired physical properties of mild-steel castings and which are well known to the producers of steel castings.

The above statements contain no new revelations to those engaged in the welding industry, yet it is believed that the method of presentation which follows may clear certain obscure thoughts concerning the mechanics of the development of cyclic heat conditions in the weld metal in course of laying or producing the deposit.

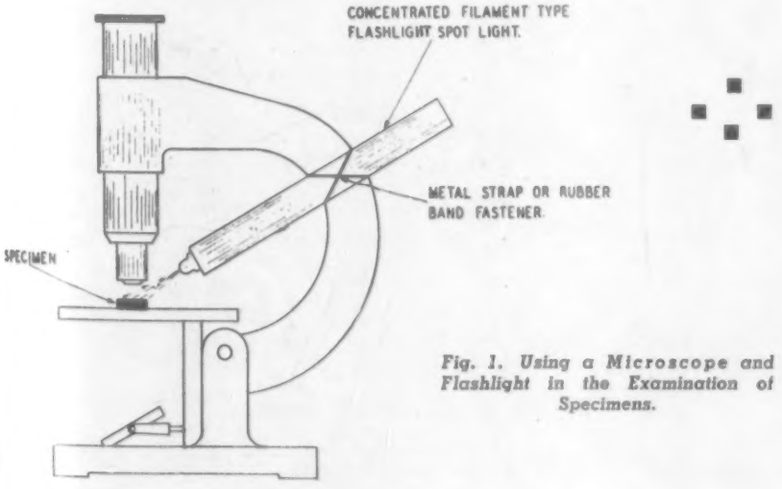


Fig. 1. Using a Microscope and Flashlight in the Examination of Specimens.

It is further believed that the better understanding of such matters may help to solve the problem of how to obtain the desired physical characteristics in the weld metal at will by means of manipulation control. It is entirely within the reach of a welder to produce, when circumstances permit, at will and using electrodes from one container or lot, weld metal varying from 6,000 to 10,000 lb. per sq. in. in tensile strength and from 5% to 15% elongation in 2 in.

Strength Is Increased at Expense of Ductility

It is believed that there are not many occasions when one has to produce mild steel of the maximum possible tensile strength for such must be necessarily, as weld metal, of the lowest ductility as well. On the other hand, the general requirements in good engineering practice call for the production of weld metal of the best possible ductility.

In the following it will be described why such widely different results may be obtained from one brand and size of mild-steel electrodes. Anyone may conduct the test.

A 100-power miscroscope, such as may be purchased for $1.00 to $3.00 in any department store or mail-order house, is all that is needed in addition to the few scraps of flat stock and a few electrodes. Fig. 1 shows how to use a concentrated-filament-type 10-cent store flashlight as the means of making the microscope useful for metallurgical examinations.

We proceed by depositing a single bead of weld metal on a piece of flat stock, about $\frac{3}{8} \times 1\frac{1}{2} \times 9$ in. From this deposit five sections are sawed out as indicated in Fig. 2. One transverse

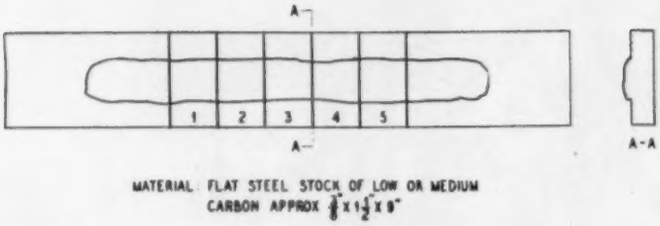


Fig. 2. Deposition of Weld Metal and Cutting Out of Sections for Etching, Polishing and Examination.

section or face of each of these five slices is then filed smooth and rubbed with emery cloth until the file marks are out, and then polished, using in sequence Nos. 1, 0, 00 and 000 emery paper until the faces so treated show a mirror-like polish. Now is the time to try out the microscope and see if any scratch marks were left. At 100 magnifications not only the faintest scratch marks will be visible but also the impurities in the weld and base metals.

Metal Structure Is Revealed by Acid Etch

The next step is to etch the polished faces one at a time with a 5% solution of nitric acid. Immerse the first specimen for a few seconds, wash off the acid under a faucet and dry in a blast of air. Put the dry specimen under the microscope and compare the pattern it reveals with Fig. 3. If the patterns are alike the etching is correct; if the pattern seen under the microscope is too faint re-etch until the desired sharp outlines are obtained. If the pattern is too dark the specimen is over-etched and must be repolished before it may be re-etched. To obtain uniform results in etching it is advisable to control the time with a stop-watch. Etch and examine in the above given manner all five sections obtained from the first single-bead deposit.

The properly etched weld metal viewed through the microscope will resemble the pattern shown in the left-hand circle of Fig. 3, and the base metal will be like that in the right-hand circle. These patterns are utterly different. Examination of the etched surface of the weld metal at ×100 shows really no pattern at all; what is seen is a conglomeration of coarse, large, misshapen crystals forming irregular groups scattered without any particular order. This is what is known as ingot structure. Raw cast steel looks like this whether it is produced by arc welding or poured from a crucible, open-hearth or electric furnace.

The base metal shows under the microscope to be made up of fair-sized grains arranged in an orderly pattern which is similar to that of a mosaic floor. The light areas are known as ferrite and consist of practically pure iron. The dark areas are pearlite and contain the carbon dissolved in iron.

Now we produce another piece of flat stock of the same material and of the same dimension as used before. A bead of weld metal is deposited on this piece, using the same brand, type and size of electrode as at first. The deposition shall occur with the same welding technique, current value and rate of progression. Wait till this bead cools to room temperature and then superpose another bead on top of it, using the above-given precautions. When cooled to room temperature, cut out a piece from the mid-section of the weld and plate, and polish and etch as before. When properly etched it will be noted that three distinctly different patterns or types of microstructures are revealed by the microscope. The top and bottom layers will appear the same as before, but the center layer (the weld metal of the first bead) will show the same pattern as shown in the right-hand circle in Fig. 4. This is called a fine-grained microstructure. Mild steel having such grain structure possesses very high tensile strength but its ductility is not what might be considered as satisfactory or desirable.

With Less Cooling of First Deposit, Grain Size Is Increased

Now take another piece of flat stock and deposit on it, in the same manner as before, a bead of weld metal, using a companion piece of the previously deposited electrodes. Allow the deposit to cool until a drop of water thrown on it stops whirling but evaporates without hissing. Immediately after having reached this temperature superpose on the first bead another layer of weld metal. Cool and cut out from its center portion another section, which shall be marked to avoid confusion. Polish and etch this section and examine it under the microscope. This will reveal that the center layer—that is, the weld metal of the first bead—

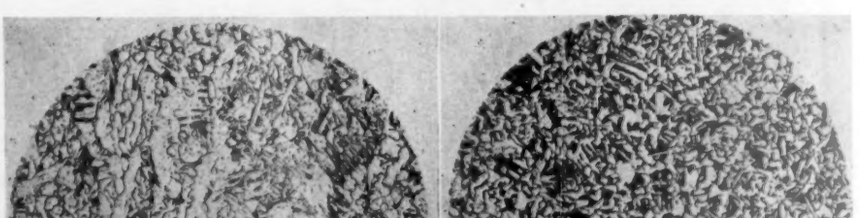


Fig. 3. Photomicrographs of Typical Unannealed Weld Metal (Left) and Plate Metal (Right).
(Magnification, ×100, reduced to ×65 in reproduction.)

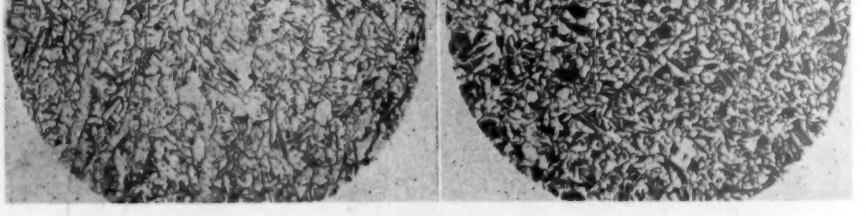


Fig. 4. Photomicrographs of Weld Metal.
(The left-hand micrograph is of metal in the last pass, and the right-hand micrograph of metal in the first pass after having been annealed by the subsequent layer. Magnification, ×100, reduced to ×65 in reproduction.)

is composed of grains of somewhat larger size than that previously observed. Mild steel, having a carbon content like that of the weld metal and composed of grains of the size revealed by the examination, just made, is of medium tensile strength and ductility.

Now once more repeat the superposition of two beads or layers of weld metal, but at this time cool the weld metal of the first layer to such temperature that it softens—not melts—soft solder. When this temperature is reached, deposit the second bead. Follow the procedure given for the first and second two-layer specimens, and repeat the microscopic examination. This will reveal that the grain size of the weld metal of the first bead is larger than those previously seen. This grain size is your assurance that the metal is of good tensile strength and it possesses the best ductility obtainable in normal welding practice from the deposition of mild-steel covered electrodes.

Grain Size Can Be Controlled by Normalization

Those familiar with metallography know that the grain structure of the weld metal of the first pass of the two-pass deposits mentioned above is that of normalized steel. Normalization is a heat-treatment which consists of heating the steel beyond its critical temperature—that is, beyond that temperature where its grain structure begins to undergo a state of change. The entire mass, which in the ingot state is a disorderly heap of its constituents, on reaching the critical temperature behaves like a troup of soldiers at rest, who, on hearing the bugle call to "fall in," assume a meticulously orderly line-up or pattern—according to the command received. So the grains formed on passing the critical temperature freeze into an orderly pattern when chilled suddenly by a blast of air. The grains formed at a temperature just above the critical are the smallest; the higher the temperature reached above the critical the larger are the grains, until finally, when the temperature approaches the plastic state, the whole regimentation process is broken up and the ingot structure reoccurs. Four slices taken from the first, the single-pass deposit, which on examination proved the ingot structure of weld metal as deposited, will be used to demonstrate this ability of mild steel to respond to normalizing heat-treatment.

Take slice No. 2 of the single-pass deposit, put it on a brick and heat it with a welding torch until it shows daylight visible red or dark cherry (about 1600°F.). Hold this color for at least one minute, then plunge the specimen into oil or water. Heat slice No. 3 to orange (about 1700°F.) and quench. Heat slice No. 4 to dark straw (1800°F.), and finally heat No. 5 to bright straw (1900°F.), and quench.

Repolish and etch these specimens and compare the microstructure of the weld metal in its newly developed condition with that of the first pass of the several two-pass samples. The comparison will make it evident that in electric-arc welding the heat input of each layer raises the temperature of the volume of the previous deposited layer beyond the critical, whence the quenching action of the surrounding mass of metal normalizes it. The volume so normalized is a function of the volume deposited.

Effect of Normalization Does Not Penetrate More Than 3/16 In.

However, experience shows that a deposit 3/16 in. thick will not effect the normalization of the underlying metal to a depth of 3/16 in. On the average, it is proven that the heat effect of the arc is sufficient to reheat to a sufficient degree to promote normalization only to a depth not exceeding ⅛ in., regardless of the size of the electrode used or the rate of the progression—that is, the thickness of the deposit.

From the above it is evident also that if one desires to produce a fully normalized deposit, the thickness of each layer or pass shall not exceed ⅛ in. and preferably 1/10 in.

In summing up, and in order to convert the results of the experiments into terms dealing with everyday welding conditions, let it be said that when the interpass temperature (the temperature of the weld metal just prior to the superposition of another layer or pass) is at room temperature throughout the entire period used in filling in the weld, the resultant weld metal is theoretically of maximum tensile strength and of minimum ductility. However, because of the coldness of the mass of the deposit, starting of each electrode is apt to be somewhat sluggish, which occasionally results in cold shuts and slag trapping. Hence, the theoretically high tensile strength is reduced and the ductility may reach dangerously low values.

Interpass Temperature of 200° to 300°F. Gives Best Results

When the interpass temperature is held between 200° and 300°F. welding conditions approach the ideal for manual operation. Starting of each electrode is easier, hence occurrence of cold shuts and slag trapping is held to the minimum or is entirely eliminated. Consequently the tensile strength and the ductility of the weld metal may be kept under close control within their specification values. With increasing interpass temperatures, a new menace shows up—undercutting. However, experienced welders on most occasions know how to cope with it by manipulation of the electrode or by reducing the amplitude of the oscillation. The hotter the interpass temperature—up to 400° to 500°F.—the greater is the certainty of the production of sound metal of maximum toughness, endurance, and, in short, of the best quality from all considerations, including that of stress distribution.

Welding Research Program Under Way

To develop improved processes in steel, non-ferrous metal and other industries, the Welding Research Committee of the Engineering Foundation has formulated an extensive program, including completion of ten fundamental welding-research projects.

Membership of the committee has been increased to twelve, representing nine major industries and the U. S. War Department. Aid of other groups, including the oil, automotive, aircraft and ship-building industries, has been enlisted. Industries now participating in the work of the committee are railroads, public utilities, steel, structural-steel fabrication, resistance welding, machinery, and manufacturers of pressure vessels and of arc-welding and gas-welding apparatus and supplies.

Forty coordinated researches are being carried out in educational laboratories in the United States and Canada. Fundamentals of resistance welding will be the focal point of a large-scale project at Rensselaer Polytechnic Institute, Troy, N. Y. The institute has offered to purchase $12,000 worth of engineering laboratory equipment for this purpose, provided a research fellowship is established by automotive and refrigerator manufacturers. Studies will be made of the optimum currents, time, pressures, size, and shape of electrodes for welds in various materials. Another phase of the research will deal with the effect of carbon and manganese ratio on the weldability of steel.

The Structural Steel Research Committee has established a fellowship at Cornell University for the study of fatigue of welded joints. A comprehensive program, calling for the raising of $25,000 to $30,000, has been drafted at the University of Illinois under the guidance of W. M. Wilson, member of the university's research staff.

Plans to co-ordinate hundreds of scattered welding researches are being formulated by the Welding Research Committee.

Flame Cutting—I

First of Two Articles

■ By PAUL ROSS

IT IS generally known that the torch cutting of carbon steel is not a mechanical operation, but depends on a chemical reaction. The steel to be cut is heated to full red, using only the preheating flames, with the cutting valve closed. When the cutting valve is opened, a stream of pure oxygen strikes the spot between the heating flames. If the steel is hot enough it ignites and burns readily.

PRACTICAL aspects of torch cutting are discussed by the author, including the proper care of equipment, adjustment of the torch, the design and use of standard and special tools and of cutting tables.

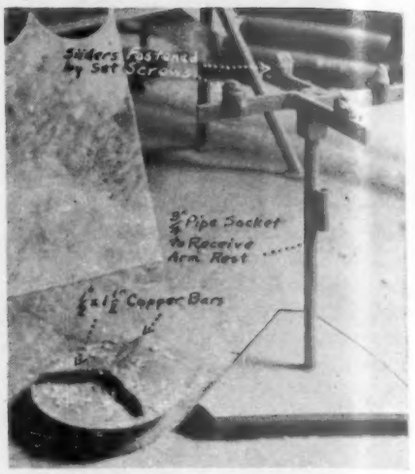
Cutting Orifice Must Be Clean and Straight

If the oxygen issues from a small hole of clean, straight bore, then the stream will be straight and will penetrate the steel in a straight line, much the same as a hacksaw. If the torch is moved ahead at an even rate of speed, with no side motion or irregularities, the cut will be almost as smooth as a sawcut. If the tip is "dirty" that is, if the inside of the cutting orifice is not smooth and straight the oxygen will not come out in a straight, smooth stream, but will swirl and eddy. If the cutting orifice is partly clogged, the stream of oxygen will be deflected to one side, and the cut will not go straight through the plate, even when the torch is held properly. It is just as important for a torch cutter to keep his cutting tips in good shape as it is for a carpenter to keep his saw in condition.

The mixture of steel and oxygen is iron oxide. It is not correct to call it slag, though most of us do. The iron oxide is thin and watery while at high heat and runs down the face of the cut, thereby helping to heat the solid metal just ahead of the cut. As the cutting moves ahead, the heating flames heat the top surface of the metal while the remainder of the thickness is heated by the burning of the iron in the cut, and by the hot oxide which runs down over it. The cut can travel only as fast as the metal can be heated to the cutting temperature. That is why hot steel can be cut faster than cold steel and is one of the reasons for preheating the stock.

Selection of Clothing Is Important

Every cutter should try to dress himself to suit his work. Leather aprons will prevent a lot of burns and save clothing. If overalls are worn they should be well starched. Starched cloth will not ignite from sparks as quickly as soft cloth. The cap should fully cover the hair to prevent burns to the scalp. Shoes should preferably be of the "Congress" or "Gaiter" type with no strings or openings in front. If shoes are kept oiled or polished, the drops of iron oxide which strike them will bounce off more often than not. Leather sleeves such as arc welders use will very soon pay for themselves in the shirt sleeves they save, to say nothing of the burns on one's arms.

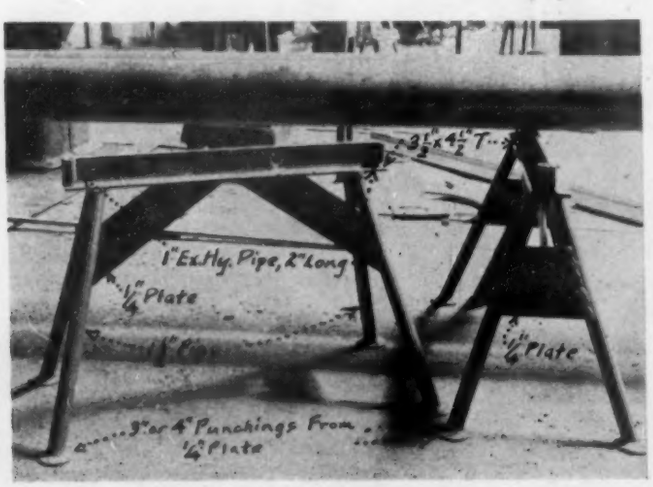


Cutting Stand with Rotating Top Member.

(Such a stand is indispensable for hand cutting of circular parts. The piece of ¾-in. pipe welded to the column holds a piece of rod which acts as an arm or torch rest when beveling. The piece on the floor at the left is used on the cutting stand when small pieces are cut; the copper bars on top are bronze welded to the circular plate and, when new, were ½x1½ in. and the top edge was sharp.)

The kind and number of tools the cutter owns will be governed by what the company furnishes. The cutter should carry in his pocket an adjustable wrench (crescent pattern), a hook scale 9 or 12 in. long, and a spark lighter, among other tools that will be mentioned later.

Each cutter should own or keep in

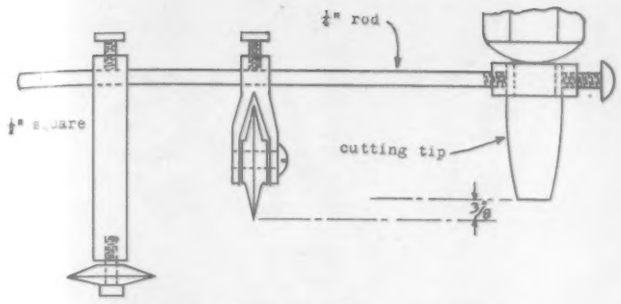


Side and End Views of Horses.

(The pieces of 1-in. pipe welded at the side of the T's at each end are to receive pins which keep pipes from rolling off.)

Tools Needed by a Torch-Cutting Shop.

(At the left are large and small dividers, both pairs of which are provided with a chuck for holding ¼-in. round soapstone pencils. Next is a circle-cutting attachment for a hand torch. The chisel consists of a chrome-nickel-steel handle welded to a blade of 1.10%-carbon steel; it is useful in removing the oxide from the torch-cut material. Next is a center punch, and to its right is a roller torch support used when hand cutting straight lines or irregular curves, and described more fully on the next page. At the extreme right is a pair of bending irons for shaping the aluminum template for a shape-cutting machine. These tools were all hand made.)



Attachment for Cutting Straight Lines and Curves.

(Either one or both rollers may be used. They should be very thin and sharp on the edge so as to encounter the least amount of scale or dirt on the material being cut. The wheels were obtained from pipe cutters. The gauge wheel is used for splitting angles, channels, etc.)

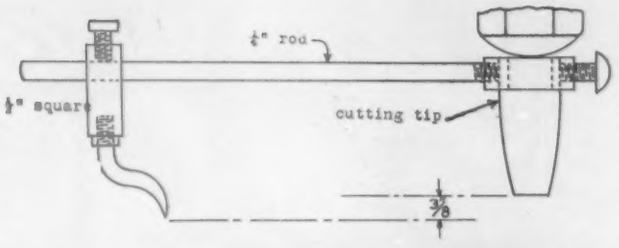
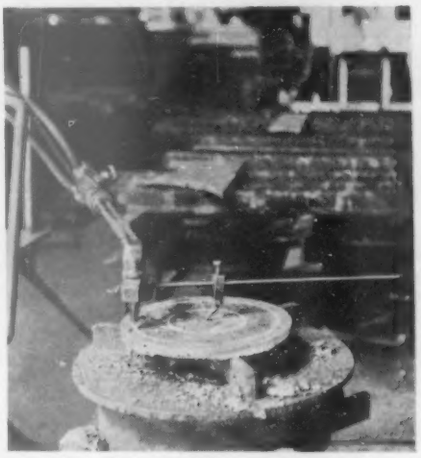


Diagram of Circle-Cutting Attachment and View Showing How It Is Used.



his possession a good pair of well-fitted goggles. It is almost as important to own one's goggles as it is to have a personal tooth brush. Goggles fitted to one face may not fit another. It is necessary, in cutting, that the goggles fit closely so that flying sparks and scale do not get under them.

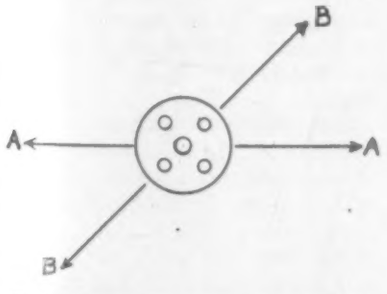
Requirements in shop equipment and tools depend on what is to be cut. Let us assume that a general assortment of pipes, plates, structural shapes, etc. are to be cut. The shop should have a crane of not less than ¾-ton capacity, and larger if large pieces or plates are to be handled. This crane should have a high-speed chain block or power hoist of appropriate capacity. The shop should have a concrete floor and at least four "horses". T-sections with pipe legs, stem up, make very serviceable horses.

Preventing Hot Oxide from Sticking to Concrete Floors

That portion of the floor over which cutting is done should not be swept with a broom. If cleaning is done with a hoe or square-point shovel, enough dust will be left on the concrete to keep hot oxide from sticking to the floor as it falls from the cut.

The gas hose should be of good quality and of large enough size to do any job which will probably ever be brought in. The oxygen hose and acetylene hose should be fastened together at one-yard spacing. When you get a good hose, treat it with some respect. Don't drop hot oxide or scrap on it. Don't let it rest on hot iron. Don't kink it, and don't drop plates or heavy objects on it.

Whatever cutting torch is used, treat it like a precision tool and follow the manufacturer's instructions. The makers have spent time and money to find the proper size of tip-nozzle for each thickness of material and the best oxygen pressure. You can do no better than to follow their advice.



The Torch Tip Should Be Moved in the Direction A-A Rather Than Along B-B.

Regulators Should Be Limited to Those Designed for Cutting

There is much misunderstanding of regulators and their use in cutting. Some people have the idea that "any old regulator" is good enough to cut with. Nothing could be farther from the truth. The regulator should be large enough to pass the amount of oxygen required without getting too cold, and should be able to hold the pressure constant while the cut is in progress. A few pounds "creep" between idle and cutting is annoying, but can be overcome by setting the pressure with the cutting valve open. If the regulator "bucks"—that is, if the pressure varies while the cut is in progress—trouble is sure to occur and the cut may be lost.

A torch-cutting shop should have a compressed-air outlet and hose, if air is available at a reasonable cost. If air is not to be had, don't use oxygen to blow dirt and dust off the work. A broom or brush is much cheaper than oxygen.

Tables and Stands Are Handy for Manual Cutting

A table made of angle legs and a plate top is very handy for small work. Such a table is almost a necessity if small pieces are to be marked and center-punched.

For hand cutting of small circles, a stand with revolving top is useful. This is made of a piece of shafting, 1 to 1½ in. in diameter, welded to a base plate and provided with an easy-turning top member. Large plates are laid directly on this stand and rotated with one hand while the torch is held with the other.

For smaller pieces and for cutting openings such as pipe flanges, an additional member is used on the cutting stand. This consists of a base ring (this may be a 2 in. section of 10 in. pipe or a ¼x2 in. bar, 30 in. long, rolled round), a ¼ in. plate, 12 in. in diameter, and three pieces of ½x1½ in. copper bar, each 6 in. long. The base ring is welded to the bottom side of the plate, and the copper bars are bronze welded to the top, forming a Y. This not only supports any size circle evenly, but keeps most of the heat away from the bearing of the cutting stand. If the tops of the copper bars are kept rather narrow, the cut will pass over with little or no effect on the cut itself.

Torch Support and Tram Help to Make Smooth Cuts

For hand cutting, two attachments are needed for the torch. These are a roller torch support, and a tram. The quality of the cut is improved and the speed is greatly increased by the use of these aids. Circular pieces which require machine finish can be cut as well by this method as with a torch-cutting machine; and if only two or three are required, they can be cut in less time than the machine can be properly adjusted.

In operation, you lay the work on the cutting stand, then lay the circle to be cut, and center punch rather deeply. The cut is started at an edge and brought to the line of cut or until the tram point drops in to the center punch mark. The torch is held

level and still while the work is rotated under it at the best speed. After the tram is set for the proper size, any number of pieces can be cut with no marks or layout other than centering. In cutting inside circles, the plate is pierced a little inside of the cut line, and pushed out to the cut, to avoid the ragged edge caused in piercing. The roller support may be used on either side of the torch as desired. Cutting is done to marks and the torch is pulled toward the operator, so that the mark is visible up to the point of cut. Also, the operator's hand is over cold plate, while, if the torch is pushed away from him, his hand is immediately above the cut and gets uncomfortably hot.

It is surprising how much cutting can be reduced to straight lines and circles, and accomplished with these two attachments. They are so quickly changed that any time so lost is made up in a few inches of cutting.

A full circle is cut without closing the cutting valve, and as much as 2 or 3 ft. of straight cut can be made in the same manner.

Good Cutting Requires Clean Tips of Proper Size

Good cutting can be done only with good tips of proper size. The holes in the tip should not be reamed out with awls, ice picks, etc. They should be cleaned as often as they need it, with the proper size of twist-drill. Every torch cutter should have a set of drills to fit all the tips he uses. Any manufacturer will be glad to furnish a chart of drill sizes for his tips. If one does not want to invest in several wire chucks at a dollar apiece, the drills may be mounted as follows: Get a piece of carbon block and drill ⅜ in holes ½ in. deep. Flatten or kink the shank end of the drills. Fill the holes, one at a time, with babbit and, using pliers, set the drill in the molten metal and hold in the center, and straight, until the babbit sets. After all the drills are mounted, break the carbon away carefully and, there you are. These may be marked for easy identification by filing one flat side on the smallest one, two flat sides on the next size, and so on.

Keep your tips clean. After a cutting tip has been used a long time the holes will be bell shaped at the end, and no amount of cleaning will make them cut nicely. At this time one should either throw the tips away or give it a good dressing as follows: Smooth the end of the tip with a fine file or emery cloth. Take some light,smooth tool, lighter than a hammer, and strike very light blows squarely on the end of the tip. This will upset the soft copper and partly close the holes. Hold the tip in the hand so as not to damage the seat. Hit only two or three blows and then ream with the proper size of drill. The preheating holes will have to be reamed also. If these holes do not look clean, or have square edges, repeat the above.

Cross-Section of Tip in Bad Condition.
(When tips have reached this condition, clean, smooth cuts are impossible. Copper tips should be dressed as described in the text. The cutting-oxygen orifice must be a clean, straight bore.)

Copper tips can be made almost as good as new if the above treatment is carefully carried out. Bronze tips cannot be reconditioned by this method, but may be filed on the end enough to square up the holes.

Leaky Seats Cause Erratic Torch Operation

When the torch is lighted, if it pops at regular intervals, there is probably a leak in the seat. This will admit mixed gases to the oxygen orifice. As soon as this passage is full, it will explode, causing the pop. The greater the leak, the oftener the explosions will occur. Most often a tip with a perfect seat will remedy the trouble. Sometimes the torch-head will have to be reseated.

Inspect the torch for leaks by immersing the cutting end in water. Keep the valve-packing nuts tight enough that the valves do not turn at a touch. It is very annoying to have the preheating flames thrown out of adjustment while cutting. Turn the torch off by closing the acetylene valve first. Do not close the valves too tight—just enough to stop the flow of gas. Jamming the valves too tight while the torch is warm will injure the seats.

Good cutting, either hand or machine, depends on a number of factors, all of which are important: (1) Proper size of tip. (2) Condition of tip. (3) Size of preheating flames. (4) Oxygen pressure. (5) Speed of travel. (6) Steadiness of cutting-tip movement.

Preheating Flames and Speed Must Be Adjusted for Work at Hand

The proper size of tip and the oxygen pressure can be read from a chart. The condition of the tip (cutting-oxygen hole) has already been discussed. The preheating flames will have to be adjusted according to the cutter's own judgment. If the flames are too hot, the top of the plate will melt and the cut looks ragged, while if the flames are not hot enough, the cut will not travel as fast as it should. The speed of travel should be as fast as the tip will cut, and too slow a speed is nearly as bad as too fast. In plate 2 in. or more thick, the cut can be lost by moving the torch too slowly. Having found the best speed, the torch should move regularly, smoothly, and steadily at that speed.

So far as quality is concerned, the difference between hand cutting and machine cutting is, the machine can move the torch in the line of cut at a uniform speed and without vibration—the human hand cannot. If the cutting tip has three or four preheating flames, it will cut faster if it is positioned so that two flames are ahead of the cut.

Best Cutting Is Done in Comfortable Positions

It is possible to reduce the effect of the "human element" by selecting a comfortable position and using some sort of arm rest. If the hose is thrown over the shoulder (right shoulder for right-hand man) with just enough slack to permit freedom of movement, and the left forearm is rested on something of convenient height, it will be found that torch control is easier and better. Resting the tubes (just back of the torch head) lightly in the thumb and finger, and the torch may be pushed or pulled in the manner of a pool cue.

(To be concluded next month.)

Controlling Distortion in Cutting and Welding Job

By J. H. COOPER
Welding Engineer, Taylor-Winfield Corp.

In the final assembly of the main frame of a 200-ton chain-testing press, a hydraulic cylinder is bolted between the two side rails, using the drilled holes at one end of the frame.

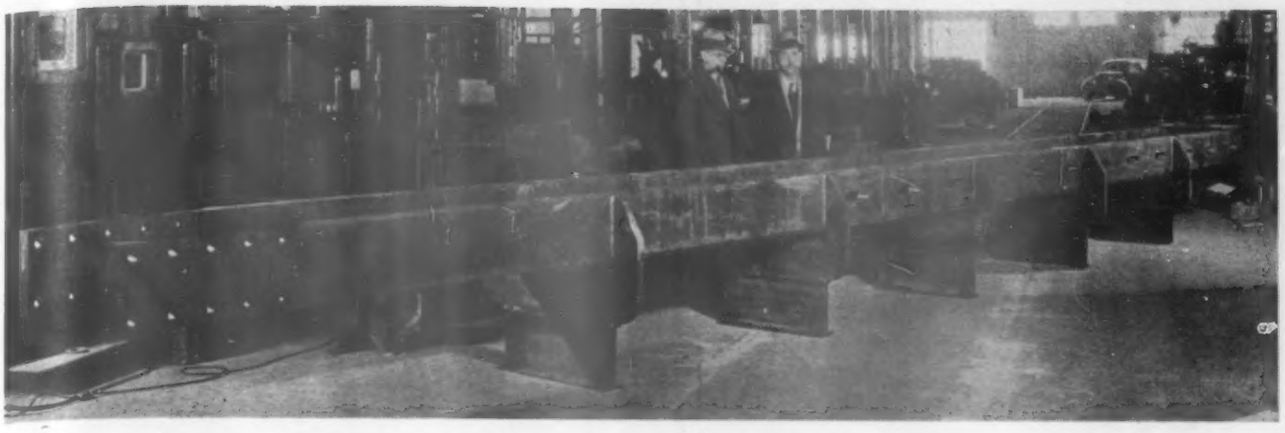
In operation, one end of the chain to be tested is restrained by means of a bar inserted through one of the matching pairs of 2½x10-in. slots cut in the side rails. The other end of the chain is attached to the moving piston of the hydraulic unit, and actuation of the piston loads the chain to the desired degree.

The press is so designed as to make very efficient use of the weld metal. The saddles perform the function of supporting, locating, and stiffening the side rails. All the testing load is taken by the side rails in compression.

The main frame as fabricated has a weight of 14,000 lb., and is 38½ ft. long, 36 in. high, and 41 in. wide.

The two side rails, being 38½ ft. long, 12 in. wide and 3 in. thick, required more than ordinary care in fabrication. The most practicable way of obtaining such sections was to gas-cut two pieces for each rail from 3 in. plate, out of 20 ft. long standard sheets, and join them end to end to give a total length of 38½ ft.

As the customer had specified these side rails to be straight within a tol-



Main Frame of Chain-Testing Press After Assembly and Welding.

erance of 1/16 in. in 38½ ft., great care in gas cutting and welding was exercised.

Knowing from experience that to cut such a section when it was free to move under the unequal expansion caused by the heat of cutting one side only, would result in a curved rail, we decided to cut both sides at once and leave the rail "tied-in" to the main plate as shown in the diagram, until cold.

In accordance with this theory, two holes, 12 in. apart, were pierced with an oxy-acetylene torch at one end of the sheet of 3 in. plate and a double cut made from these holes to a point approximately 3 in. from the other edge of the 20 ft. plate. After cooling, the short uncut sections were cut out and a perfectly straight section was the result. The 2½x10 in. slots were located and cut by means of a gas-cutting templet.

Then one end of each section was given a gas-cut 'double V' bevel for welding, and the four sections were aligned for joining to make the two long side rails. After tack welding, great care was taken in alternating the welding from end to end of each bevel and from one bevel to the other to maintain a straightness to meet such an exacting tolerance. As the press was not to be given a stress-relief anneal, the locked-up stresses must be so proportioned as to balance as much as possible.

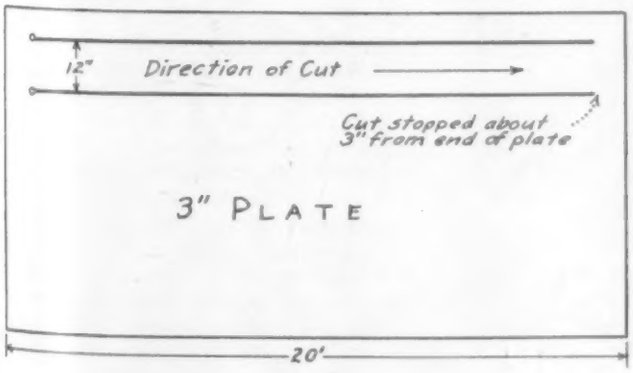
An electrode of the heavily coated mineral type was used with a. c. welding power supply. The excellent ductility of such deposited weld metal prevented any cracking under locked-up stresses of fairly high magnitude.

This press was designed by the Charles F. Elmes Engineering Works, of Chicago, and fabricated by the Taylor-Winfield Corp., Detroit, Mich.

A.S.T.M. Holds 40th Annual Meeting in New York

The 40th annual meeting of the American Society for Testing Materials was held on June 28 to July 2 at the Waldorf-Astoria in New York City, and was attended by 1,535, exclusive of those just visiting the exhibits. This sets a high mark for registered attendance at these conventions. A. E. White, professor of metallurgical engineering, University of Michigan, Ann Arbor, Mich., was elected president, succeeding A. C. Fieldner. The 1938 annual meeting will be held at Atlantic City, and the next regional meeting and group meetings of committees will be held at Rochester, N. Y., during the week of next March 7. The exhibit of testing apparatus and related equipment held in conjunction with the New York meeting was the most extensive one the Society has ever sponsored.

At the 19 technical sessions, over 100 technical papers and committee reports were presented. Of particular interest to metal-working and welding plants was the approval, on the recommendation of Committee A-1 on Steel, of the publication of seven new tentative specifications. Four of these cover various types of alloy-steel plates for boilers and other pressure vessels. Two cover intermediate alloy-steel still tubes and heat-exchanger tubes. The seventh covers iron and steel filler metal (arc-welding electrodes and gas-welding rods), and this one is described more fully elsewhere in this issue. Among the papers presented was one on "Weld Metal as an Engineering Material and Some Methods of Testing," by L. J. Larson, of the A. O. Smith Corp., of Milwaukee, Wis.



Scheme for Cutting Side Rails From 3-In. Plate Without Distortion.

Forms Automotive Council of American Welding Society

The Automotive Council of the American Welding Society has just been organized through the Detroit Section of the Society. C. L. Eksergian was elected chairman, and the following were elected to membership: C. A. Adams, consulting engineer; E. L. Bailey, Chrysler Corp.; J. Caille, Murray Body Co.; D. H. Corey, The Detroit Edison Co.; Col. A. S. Douglass, The Detroit Edison Co.; C. L. Eksergian, Budd Wheel Co.; W. H. Graves, Packard Motor Car Co.; J. H. Hunt, General Motors Corp.; M. B. Gathman, Fisher Body Co.; J. R. Lex, Fisher Body Co.; H. M. Northrup, Hudson Motor Co.; J. W. Parker, The Detroit Edison Co.; W. Spraragen, American Welding Society; C. Sinclair, Kelsey-Hayes Wheel Co.; J. D. Tebben, P. R. Mallory & Co.; and D. Wallace, Chrysler Corp.

J. B. Tebben, Chairman of the Detroit Section, American Welding Society, says: "The automotive industry has made great strides in welding developments, particularly in the resistance-welding field, and it is only in keeping with the progress of the industry itself that the Welding Society should take steps at this time to form the Automotive Council."

Welding 11-14% - Manganese Steel

By B. H. PAYNE
General Manager, Stulz-Sickles Co.

HADFIELD 11 - 14% - manganese steel is used largely for parts subjected to severe impact and abrasion. Most dippers, teeth, lips, gyratory, roll and jaw crushers, street-railway and railroad frogs and crossings are made of 11-14%-manganese steel. Welding of parts of this kind is done largely for the purpose of replacing the metal that has been worn away or repairing broken or cracked pieces.

In addition to manganese, which ordinarily runs from 11% to 14%, this steel contains other elements. For example, carbon usually runs one-tenth of the manganese content, or about 1% to 1.30%, and the welder will readily recognize that steels of such high carbon should be welded with the least possible heat.

Castings Are Made Tough by Heat-Treatment

When 11-14%-manganese-steel castings are removed from the mold, they are very weak and brittle, but are made strong and tough by heating to about 1900° F. and quenching in water. Heat-treated or -toughened manganese steel is rendered brittle by heating to a dark-red heat, followed by cooling; water quenching from dark-red heat has no toughening or strengthening value whatsoever. Heat-treated manganese steel reheated to temperatures above dark-red heat and up to the usual 1900° F. and then quenched in water is again made strong and tough and the degree of toughness will depend entirely on the degree of temperature of the part when quenched in water.

The slow cooling of heat-treated manganese steel again makes it weak and brittle and of about the same structure as the casting was originally, before heating and quenching. A manganese-steel casting that has been made weak and brittle may again be toughened by reheating to 1900° F. and quenching in water, but under no circumstances should the steel ever be heated to almost its melting point.

Weld Is Strengthened by Adding Nickel

When welding 11-14%-manganese-steel with nickel - manganese - steel welding electrodes containing 11-13½%-manganese, the nickel in the electrode mixes with the other elements in the casting, and where the welding operation is made and the metal brought to the melting point it is strengthened by the inclusion of nickel, but beyond that point is what is termed "a black heat line," which becomes a weak part in the parent metal. This black heat line can be either very close to where the metal is melted by the welding operation or it can be moved into a heavier section of the casting, depending entirely on what amount of heat is put into the metal.

Heat Should Be Kept to the Minimum

All users when repairing parts of this kind with nickel-manganese-steel electrodes should be cautioned to keep the heat at the minimum, using as low an ampereage as possible consistent with good penetration, and skip from place to place on the parent metal. Very often when several parts are being reclaimed it is advisable to weld on one and rotate from one to the other, in order to keep the heat at the minimum in the parent metal.

It can be readily recognized from the foregoing that the oxyacetylene process should never be used for repairing manganese steel, not because of any fault of the oxyacetylene process itself, but because of the peculiar type of metal that is being welded, as this steel will be damaged by the temperature developed when using the oxyacetylene process.

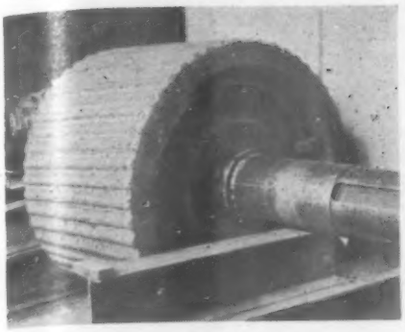
Coupling Box Being Restored by Welding With Nickel-Manganese Rods.

Broken and Worn Wobblers and Spindles Restored by Welding.

The coefficient of expansion of 11-14%-manganese-steel is higher than that of ordinary carbon steel, and naturally the cooling stresses set up when welding are much greater than when welding ordinary steel. This expansion must be taken care of when repairing 11-14%-manganese-steel castings by welding, for as the metal cools the weld will crack. There is only one way to take care of contraction and that is by peening while the deposited metal is cooling, thereby offsetting the contraction by expanding the weld deposit by the peening operation. Just tapping lightly with a hammer is not sufficient; the best method is to use an air gun or, if that is not available, a machinist's hand hammer, pounding the metal vigorously until it is cool.

Weld Is Peened While Still Hot

The metal should be peened before it has had time to cool. If using an 18-in. electrode, deposit only half of it and then peen the deposited metal immediately, for if too long an interval is allowed to elapse before peening cracks will appear. The strength of welds made with nickel-manganese-steel electrodes is due entirely to the fact that the correct amount of carbon, manganese and nickel are distributed throughout the deposited metal uniformly.



Filler Manganese Bars Welded Onto Carbon-Steel Roll Crusher.

When I speak of nickel-manganese-steel welding electrodes I refer to all the elements being contained in the steel. In the case of some electrodes the manganese and the nickel are contained in the coating, in which case invariably a large portion of the manganese is lost into the air during the welding operation. Therefore, the amount of manganese in the coating must be great enough to take care of this loss and still give a deposit containing not less than 11% manganese to prevent brittleness. As the manganese content falls below 11%, brittleness increases. When welding with alternating current, the electrode should be coated with a flux to act as an arc stabilizer. Heavy flux coatings on nickel-manganese-steel electrodes, particularly rods that lay a heavy slag deposit over the weld metal, tend to drive the heat into the parent metal, whereas every effort should be made to keep the heat out of the parent metal during the welding operation. Nickel-manganese-steel electrodes are air-toughening and should be welded exposed to the air. The maximum strength is obtained in a weld deposit made from a nickel-manganese-steel electrode that is properly deposited and vigorously peened. No electrode should be used on 11-14%-manganese-steel that contains other than the usual elements found in manganese steel, with the exception of the addition of the proper amount of nickel.

Arc Must Be So Manipulated as to Aid Escape of Gases

When welding with nickel-manganese-steel bare welding electrodes, using direct current, the polarity of the machine should be reversed—that is, the rod should be positive. The electrode will sputter, and the deposited metal boil; and if you move your arc steadily forward there will be no time allowed for the escape of the gases, thus resulting in a porous deposit showing many pin holes. To overcome this, the arc should be moved in a half-circular motion, from left to right, as the arc is advanced. This keeps the metal in a molten condition and allows the gases to escape; and while it gives a wider bead, up to ¾ in., you get a sound weld deposit. You will find, however, that as you break the arc a crater is developed; but to prevent this it is only necessary to make and break the arc several times and fill up the crater in this manner.

After depositing one-half of an electrode, start the peening operation from the start of the bead and not from where the arc is broken, as you will find where the bead has been started the metal is nearly black.

For alternating-current welding, nickel-manganese-steel welding electrodes must of necessity have a coating for arc stabilization, but only a very light coating is necessary.

Beveling Can Be Done With Torch or Grinding Wheel

When you are repairing a cracked or broken manganese-steel casting, it is essential that the part be clean and of sound metal. While at one time the best procedure for disposing of unsound metal was to grind it, it is a very expensive method, and we have since found that very little heat is imparted to the parent metal when it is cut with the oxyacetylene torch. We find that the depth of burning does not amount to more than ¼ in., and it is very easy to grind off this small amount of metal after cutting out with the torch. In other words, you clean up the oxidized metal by simply finishing with a grinding wheel. Very often cuts made with the torch are so well done that it is not even necessary to grind out any great amount of oxidized metal. Always use a single-V joint. Be sure to puddle your weld deposit, using a half-circular motion and peen vigorously as each bead is deposited.

When welding cracks in dipper fronts it is good procedure to burn a hole through at the end of the crack, which you fill up and gradually bring your weld forward to the front of the bucket, being careful to peen each half of an electrode deposited.

Welding Manganese-Steel Track Work.

Close-Up of Rebuilt Dipper Teeth.

Most welding of manganese steel, however, has to do with replacing worn surfaces to their normal size—for instance, a railroad frog or crossing. Unless you are familiar with frogs and crossings you are not aware that while they appear to be made of very heavy sections of castings, they are cut out underneath and what appears to be a very heavy section quite often is very thin. Parts are designed in that manner so that better heat-treatment can be put into them when they are originally cast; therefore, such parts are easily overheated, and the welding operation should be so handled as to keep the heat out of the metal. Railway maintenance engineers have found it advisable to maintain their frogs and crossings by welding, and they now have more of a maintenance job done on them than a reclaiming operation.

Economical Applications of Wedge Bars and Filler Bars

Manganese-steel castings are found in many industries, but one of the largest uses of them is for shovel teeth, crushers, etc. To rebuild a worn-down shovel tooth by the drop-by-drop method of welding is rather expensive. However, there are now on the market suitable sizes of wedge bars, available in standard lengths. These can be cut to any desired width and applied to worn shovel and dipper teeth by attaching with nickel-manganese-steel electrodes. These repaired shovel teeth are returned to service after being hard-surfaced back of the point where they obtain the most abrasion, and if the work is properly done they will resist impact and abrasion better than new shovel teeth.

Applicator (filler) bars made of nickel-manganese steel, of the same composition as the welding electrodes, can be used where a part has been worn to such an extent that it would not be economical to rebuild it entirely by the drop-by-drop method of welding. These bars are obtainable in various sizes and shapes. In applying them, depending on the position they are placed in, the heat generated in the welding operation rises through the applicator bar and much less of it will get into the parent metal, which

is a desirable condition. These bars should first be tacked in various spots and then firmly attached by laying a heavy bead, skipping from place to place. As the deposited metal is cooling, not only should it be peened but the bar should be peened as well, since it is the hot peening of nickel-manganese steel, whether in deposited metal or bars, that imparts the underneath hardness that is unobtainable in new manganese-steel castings.

One should remember that manganese-steel castings after being heated and quenched in water are only tough, and they attain their hardness only when subjected to impact and compression and then only on the surface, which leaves inside these castings the tough, ductile, strong structure which stands very severe stresses.

Many of the large materials-handling companies, such as sand and gravel plants, stone quarries, and mining companies, have their own electric welding equipment, but a number of the smaller companies will have to depend entirely on their local welder for repairs. Many welding shops throughout the country are familiar with this process of reclaiming worn-down and broken manganese-steel parts and are in a position to do this work quickly, at only a fraction of the cost of new parts.

Welded Repairs Make Savings Over Cost of New Castings

Originally, when nickel-manganese-steel welding electrodes were placed on the market, they were looked on as an economy feature, as they were brought out at the start of tthe depression. The first question a user asked was, "How much will it cost to restore this part to its normal size?" That is a very difficult question to answer, for it depends entirely on how greatly the part has been worn down and how much metal and how many hours of welding it will take to restore it to its proper size. Many users, however, found out, after having a part repaired by welding, that it didn't cost anywhere near what a new one would and in many cases it was found that the reclaimed part resisted wear better than a new one.

Since business has improved and many of the manufacturers of parts of this kind are falling behind in deliveries, welding has increased tremendously. Many users unable to wait weeks for delivery of new parts, are accepting this particular type of welding and finding that they not only save in the cost of new parts, but are able to keep their parts up to normal, which gives them greater production and prevents needless shutdowns of their plants.

Naval Architects Discuss Arc-Welded Construction

At the Spring Meeting of the Society of Naval Architects and Marine Engineers, held at Chester, Pa., on June 22, over 300 members and guests participated in a program which pointed definitely toward the universal adoption of arc welding in future marine construction. The morning portion of the program consisted of a leisurely inspection of a large tanker being constructed in the yards of the Sun Shipbuilding & Dry Dock Co., for the Atlantic Refining Co.

A paper entitled "Recent Practice in Welding Large Oil Tankers," prepared by J. W. Hudson, naval architect, and T. M. Jackson, chief electric and welding engineer, both of the Sun Shipbuilding & Dry Dock Co., had been distributed prior to the meeting in order to provide ample opportunity for discussion. This paper described the details of welding, handling, and erecting the large units. The vessel described is over 18,000 tons dead weight, and 521 ft. long. The entire tank space, over 350 ft. in length, is 100% welded, and the authors considered that this is not the ultimate which may be accomplished by electric welding. Butt welding is used in all strength members, lap welding being used only in the case of brackets and vertical panel plates on the longitudinal bulkheads. The authors expressed the opinion that operating results, maintenance costs and savings will more than justify the extra expense, if any, in building welded tankers.

The formal meeting was opened in the afternoon by presentation of a paper entitled "Some Effects on Welding on Ship Construction", prepared by James B. Hunter, head of the hull technical division of the Bethlehem Shipbuilding Corporation, Ltd., Fore River Plant, Quincy, Mass. This paper described briefly some of the effects observed in the shipyard practice and methods due to the substitution of welding for riveting. One important conclusion is that if welding takes the place of riveting in the major portions of the structure, definite modifications of shipyard practices appear inevitable. In the case of small vessels the author stated that the trend is definitely toward welding the tank spaces completely; and in the larger merchant vessels welded bulkheads both transverse and longitudinally, also major parts of the framing, small decks and flats, are being generally welded.

In both the written and the oral discussions of these two papers opinions concerning the advantages of welded construction were notably enthusiastic, although the need for further research and experimentation was duly recognized. There is evidently a definite thought in shipbuilding circles that the reduction in weight made possible by welding, together with other advantages, will gradually reduce rivets to the vanishing point, and classification rules will undergo gradual changes until they give full recognition to the welded ship. As a whole, the session furnished a generous exchange of ideas concerning the new problems of design, construction and organization that the ship building industry is facing and left no doubt in the minds of those present that ship builders are proceeding as rapidly as possible to master the application of arc welding in their business.

Job Shop Repairs 31,000-Lb. Sugar-Refinery Roll

Recently, a cast-steel roll, which had traveled a distance of approximately 4,000 miles, was returned to service in a Porto Rican sugar refinery. The roll, weighing 31,000 lb., had been shipped to St. Louis, Mo., for repairs that involved welding and machining. The Fulton Iron Works, St. Louis, to whom the contract for repairing the huge roll had been awarded, sublet the welding work to the Atlas Aluminum Welding Co., 2913 N. Broadway. The roll was a saw-tooth affair, the teeth encircling it in bands similar to spiral stripes encircling a barber pole. The 56 teeth, originally 4 in. in height, had, through years of grinding sugar cane, worn down to 2¾ in. The process of building up with the electric arc, according to W. A. McCollum, proprietor of the Atlas company, required 850 lb. of rod and 350 lb. of strip iron. Two men were employed on the task, and the actual welding time was 267 hours. Machining was done by the Fulton company. McCollum estimates that, despite the expense involved in shipping the roll, the refinery saved about $3,000 over the cost of replacement.

Coming Events

Aug. 10-15. Mt. Pleasant, Mich. Oil and Gas Exposition, with exhibits and demonstrations.

Sept. 28-Oct. 1. Chicago, Ill., Hotel Stevens. Iron and Steel Exposition and annual meeting of Association of Iron and Steel Engineers. For information write Iron and Steel Exposition, 1010 Empire Building, Pittsburgh, Pa.

Oct. 18-22. Atlantic City, N. J., Municipal Auditorium. National Metal Congress and Exposition. Also Annual Meeting of the American Welding Society, American Society for Metals, Wire Association, and other organizations. For information write W. H. Eisenman, 7016 Euclid Ave., Cleveland, O.

Oct. 27-29. White Sulphur Springs, W. Va., Greenbrier Hotel. Annual Convention of American Institute of Steel Construction. For information write V. G. Iden, Secretary, 200 Madison Ave., New York, N. Y.

Advantages of Steel Hulls *in* River and Harbor Craft . . .

■ By EDWARD H. SYKES
Pittsburgh Correspondent, *The Welding Engineer*

THE USE of steel for barges, and for the hulls of specialized types of floating equipment in Eastern seaboard harbors, has for years been on the increase, and at present is continuing to show rapid strides. The more recent development of all-welded construction has uncovered new advantages for steel hulls. While wooden vessels still predominate in harbor craft, several factors are combining to give the preference to steel.

More than twenty years ago, the Dravo Corp., of Pittsburgh, Pa., found that wooden craft were inadequate for its own use in construction work on dams, locks and bridges on the Ohio and Mississippi River systems, and accordingly began the construction of steel hulls. Later, the organization entered the field of building all types of river craft for other users. Since that time, steel has become the dominant material for river-craft construction.

Effect of Age

Steel has many advantages over wood for harbor as well as for river service. Wooden vessels carry less as they grow older and the planking becomes water-logged, while the carrying ability of steel vessels remains unaffected, even after many years of service.

Repairs

Repairs on wooden hulls always are an uncertain element. Shipyards usually will not make estimates on repairs to wooden hulls, except on a cost-plus basis, but on steel hulls the amount of work can be readily ascertained, and a definite estimate usually given.

Ship-Worm Damage

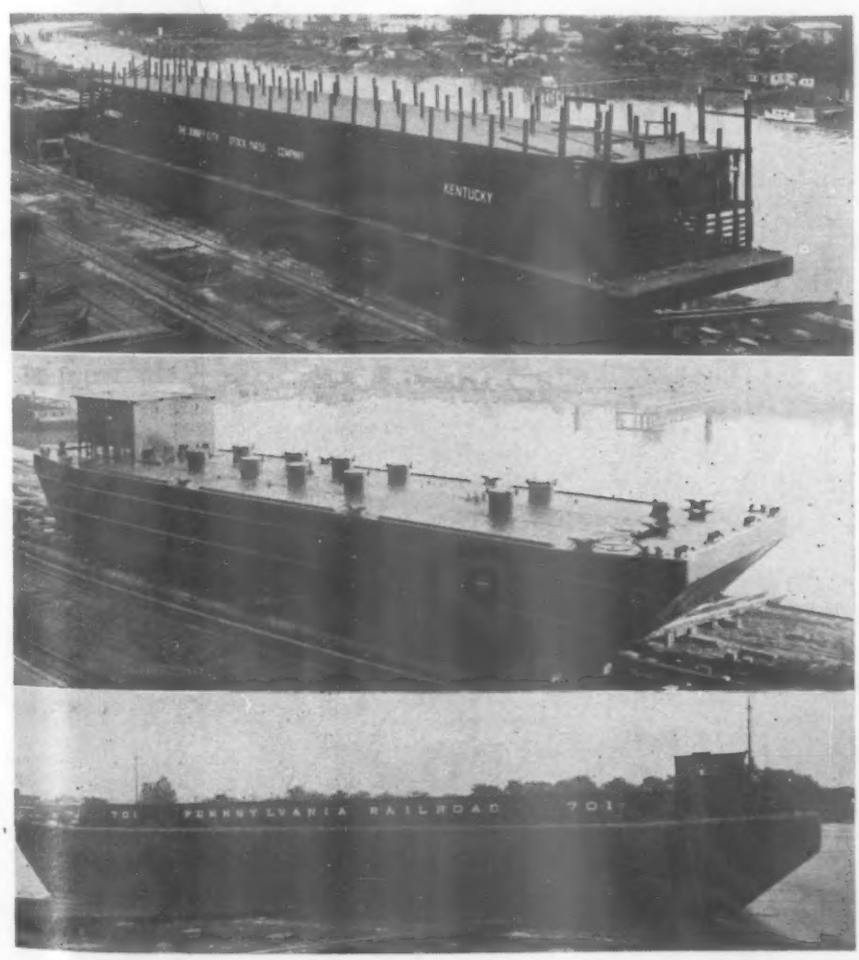
While painting of steel hulls exposed to the conditions of eastern harbors is little different from the painting of wooden hulls, damage caused by teredo navalis (ship worm) is eliminated. This advantage is growing more important since the reduction of pollution in New York and surrounding water flow is permitting the wood-boring teredo to take hold and do damage in places where its existence formerly was controlled by impurities in the water.

Lumber Costs

Rising costs of lumber and the increasing difficulty in obtaining quality lumber sufficiently heavy for construction of barges is likely to be a further influence toward greater interest in steel construction.

Structural Advantages

Steel barges also have several other advantages over wooden ones. The structural problem in the use of wood makes necessary several strong beams as transverse strengtheners, while these may be reduced to two or three cross-members in the cargo carrying part of steel barges. The probability of damage resulting from buckets striking strong beams is thus reduced. More freedom in the cargo space reduces the time and the amount of work necessary for cleaning a barge after unloading. Better design of the rake ends give easier towing qualities to the newer steel equipment. All these facts, together with faster unloading, make it possible to increase



TYPICAL WELDED BARGES
Top to Bottom: Cattle Barge, Oil Barge and Coal Barge.

the number of trips for a barge in a given time. The fact that steel barges have a high salvage value after their years of usefulness have passed, while wooden barges have not, is another factor. Steel barges can be broken up and sold for scrap, but there is practically no scrap value to a wooden vessel.

Welded Design

Just as steel barges are superior to wooden ones, so are the comparatively recent all-welded construction methods superior to riveted construction. Among the advantages claimed for welded barges are the possibility of attaining lighter weight, greater strength, more capacity, and lower maintenance. The use of welding also has been accompanied by the development of better design, which results in easier towing and greater strength for the structure.

Applications of Welding

A new application of all-welded construction for harbor vessels has been made in the cattle barge *'Kentucky'*, built recently for the Jersey City Stock Yards Co., Jersey City, N. J., by the Dravo Corp., at their Wilmington, Del., shipyards. The barge has an overall length of 196 ft., a moulded beam of 36 ft. 6 in., and a moulded depth of 8 ft. It is provided with a wooden superstructure, with two decks carrying the cattle pens.

The barge has proved satisfactory in every respect. The stock is loaded on at the stockyards in Jersey City, and is delivered from there to packing plants in New York and Brooklyn. Delivery of export shipments also is made direct to ships within the free lighterage limits of the Metropolitan District.

Steel equipment, most of which is welded, now under construction by Dravo, includes five lighters for the Pennsylvania Railroad and six sand-and-gravel barges for the Warner Co. In recent years, Dravo has built for the Eastern Seaboard service such equipment as 50-ton floating revolving cranes, car floats, terminal cargo barges, grain barges and a floating grain elevator, as well as numerous sand, gravel, terminal and oil barges.

Tentative Specifications for Filler Metal

Proposed Tentative Specifications for Iron and Steel Filler Metal (Arc-Welding Electrodes and Gas-Welding Rods) have been published by the American Society for Testing Materials. These specifications, which were prepared jointly by the American Welding Society and the American Society for Testing Materials, provide for seven groups of filler metal classified in accordance with the weld produced. Respective requirements for tensile strength range from 45,000 to 80,000 lb. per sq. in., depending on the grade, the tensile specimens used being all-weld-metal machined specimens. The elongation in 2 in. ranges from 3% to 20%. Other requirements have to do with maximum phosphorus and maximum sulphur content of the deposited metal. Standard sizes and lengths of filler metal are indicated, there being 9 standard diameters, ranging from 1/16 to 3/8 in. Other paragraphs of these specifications pertain to the bare portions of manual-welding electrodes, permissible variations in dimensions, workmanship, finish, packing, marking, inspection and certification.

Additional requirements of an optional nature are appended, these to be used if the purchaser desires further tests of a more complete nature. These include reduced-section tensile test, nick-break test, free-bend test, requirements for coated or covered electrodes, usability test, and density determination.

A.W.S. Sections Elect New Officers

The new officers of the Cleveland Section, American Welding Society, are: Chairman, E. R. Benedict, Contract Welders, Inc.; vice-chairman, Fred L. Plummer, Case School of Applied Science; and secretary-treasurer, E. T. Scott, Cleveland School of Welding, Inc.

The San Francisco Section has elected the following officers: Chairman, N. F. Ward, University of California; vice-chairman, Ted Rooney, Western Pipe & Steel Co.; secretary, J. G. Bollinger, Air Reduction Sales Co.; and treasurer, H. W. Saunders, Air Reduction Sales Co. Members of the Executive Committee are: K. V. King, Standard Oil Co. of California; E. L. Mathy, Victor Equipment Co.; and C. S. Smith, The Linde Air Products Co.

How to Prevent Fires Due to Welding and Cutting

In a special letter to insured plants dated July 10, the Associated Factory Mutual Fire Insurance Companies called attention to the rapid increase of fires caused by cutting and welding operations, pointed out the hazards, and urged necessary safeguards.

According to the record of these Companies, the increasing use and popularity of cutting and welding equipment is resulting in fires this year at a rate 45% greater than in 1936.

Most of the fires were due to the use of portable equipments in locations in manufacturing plants where it was not safe to use them or where proper precautions were not taken. It was pointed out that sparks or globules of molten metal from the operations have in some instances ignited combustible material as much as 35 ft. away.

As a remedy, it is suggested that the management make sure that the location where equipment of this kind is to be used is first inspected by a responsible person with authority who thoroughly understands the hazards and will enforce precautions. The advantage of requiring the operator to have written permission for such work is also pointed out.

Included with the letter was a sheet containing the following detailed suggestions:

SUGGESTIONS FOR FIRE PREVENTION
Portable Cutting and Welding Equipment, Gas and Electric

1. SUPERVISION. Appoint a welding superintendent or other competent employee to supervise the use of portable cutting and welding equipment. Give him authority to establish and enforce suitable precautions. Allow cutting and welding to be done only with his signed permit, only in areas designated, and only by experienced operators. Insist on precautions by outside contractors as well as by employees.

2. SPRINKLER PROTECTION. Always keep automatic sprinklers in service during cutting and welding. The possibilities of damage by fire are greatly increased if sprinklers are shut off.

3. COMBUSTIBLE CONSTRUCTION. Do not use portable cutting and welding equipment in combustible buildings unless sprinklered, and unless floors and partitions are tight. Sweep floors clean, and wet down wooden floors or cover them with sheet metal or equivalent. Prevent sparks from outdoor work entering windows, doors, or other building openings.

4. REMOVE COMBUSTIBLE MATERIAL. Before starting work, move any combustible storage, goods, or equipment at least 35 feet away. If they cannot be moved, protect the material carefully and completely against sparks by using asbestos or sheet-metal curtains or guards. Shut down processes exposing combustible fibers or materials. Carefully remove dust deposits which might be exposed to sparks.

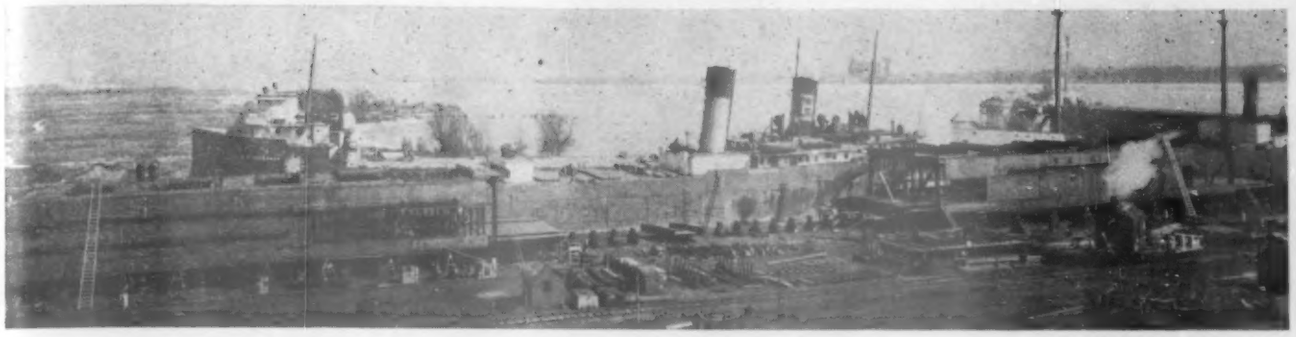
5. UNSAFE NEAR FLAMMABLE LIQUIDS. Do not permit cutting and welding in the vicinity of exposed flammable liquids or combustible vapors or gases. Thoroughly ventilate locations where flammable liquids or vapors have been present.

6. BEWARE OF CLOSED CONTAINERS. Do not work on closed containers which may have held flammable or combustible materials. A film of such material on metal surfaces may not be readily noticed but could produce explosive vapors when heated. This type of work requires special precautions. Purging with steam or air, or flooding with water, is sometimes effective.

7. EXAMINE DUCTS. Do not do cutting or welding on ducts which may contain combustible deposits without first making sure the ducts are clean.

8. EXTRA PRECAUTIONS AGAINST FIRE. Station extra men with small hose, chemical extinguishers, or fire pails to see that sparks or drops of hot metal do not lodge in floor cracks, do not pass through doors, windows, or other openings in walls or partitions, do not drop through holes to the floor below, or do not pass over or below curtains or guards protecting combustible materials. Continue watch service at the scene for a half hour after operations, to make sure that stray sparks have not started smoldering fires. Carefully inspect the floors above and below, and adjoining rooms.

9. CARE OF EQUIPMENT. Keep all equipment in good condition and follow carefully the instructions of the manufacturer for its use and maintenance.



Two 300-Ft. All-Welded Freighters Under Construction in the Yards of the Great Lakes Engineering Works

Arc-Welded Construction Increases Capacity of Freighters

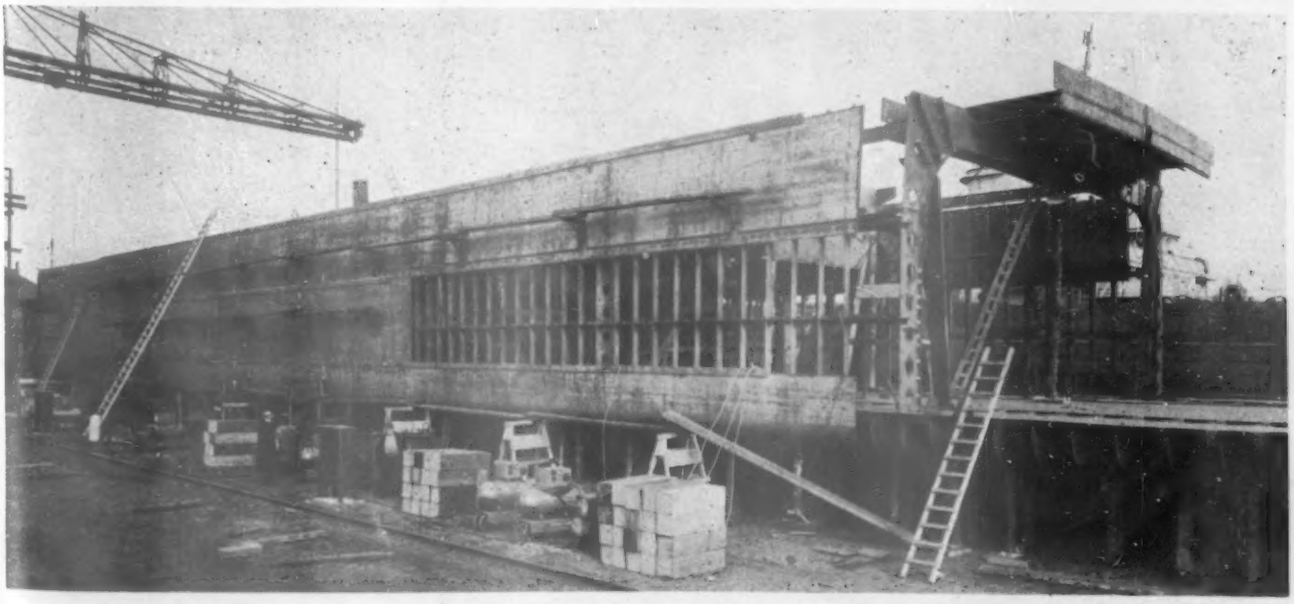
■ By A. F. DAVIS
Vice-President, The Lincoln Electric Co.

ARC-WELDED construction is responsible for an increase of 300 tons in the cargo-carrying capacity of two new freighters being built at the yard of the Great Lakes Engineering Works, River Rouge, Mich. These two vessels, which are for operation on the Great Lakes, through the New York State Barge Canal and in Atlantic coastwise service, are the largest vessels ever built on the Great Lakes by welding, and among the largest ever built by this method anywhere.

The new freighters are 300 ft. long, with 43-ft. beam, and are 20 ft. deep. The design for arc-welded construction was worked out by Gielow, Inc., New York naval architects and marine engineers, in conjunction with the builder. The vessels are transversely framed to comply with the rules of the American Bureau of Shipping. Each vessel will have twin-screw propulsion equipment.

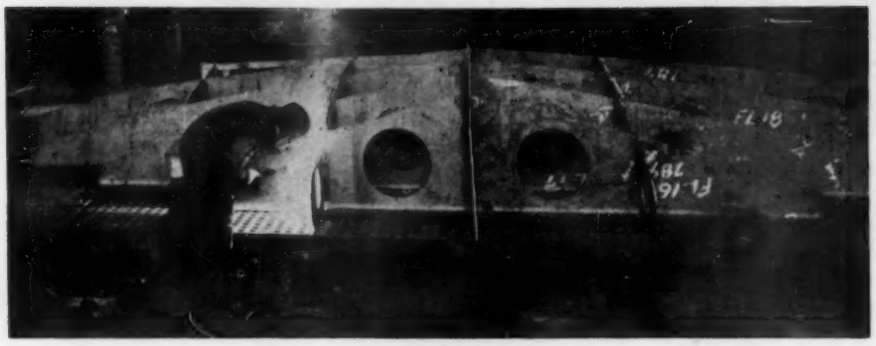
The general particulars of the vessels include a straight sheer, a 6-in. peak at the center of the upper deck, and deck sides, rolling up to the center line at the ends. There will be one deck running the full length of the vessel, and also a tank top. The deck proper will be known as the main deck, and the tank top the lower deck. The vessels will have a 6-in. tumblehome from the 12-ft. 6-in. water line to the deck.

The machinery space is to be at the aft end, with quarters for all the crew except officers on the main deck above the machinery space. The steering-engine space is to be aft of the engine space. Three cargo holds, served by nine hatches, 12x28 ft., are located



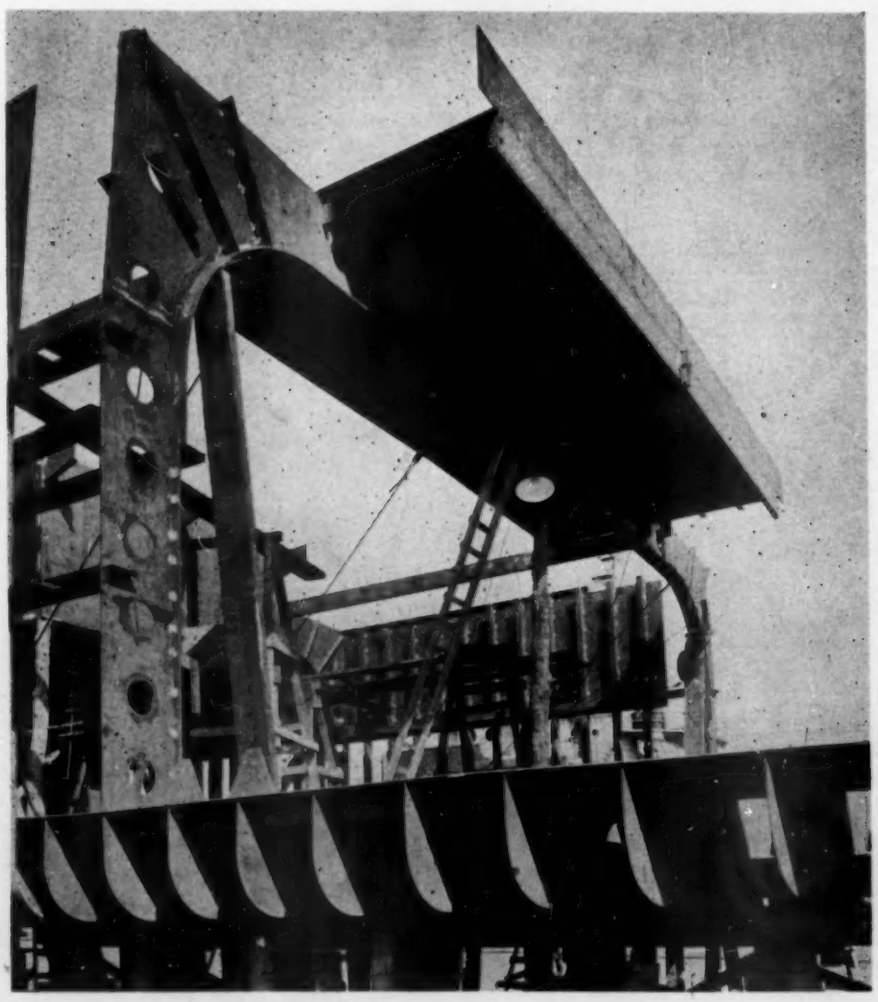
The Sheer Strake Plates Are Welded to Frames on the Ground and Then Erected and Welded in Place to the Tank Top, or Lower Deck, After Which the Bilge Plates Are Erected and Welded.

WELDING OF PARTS AND THEIR ERECTIO N



Welding One of the Floor Sections.

The Welder in the Center Is Completing a Transom, and the One at the Extreme Left Is Welding a Floor Section.



Arch Plate and Bridge in Place on the Tank Top.

Bulkheads and Other Hull S Fabr

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...N CONSTRUCTION OF 300-FT. FREIGHTER

...Fabricated on the Ground.

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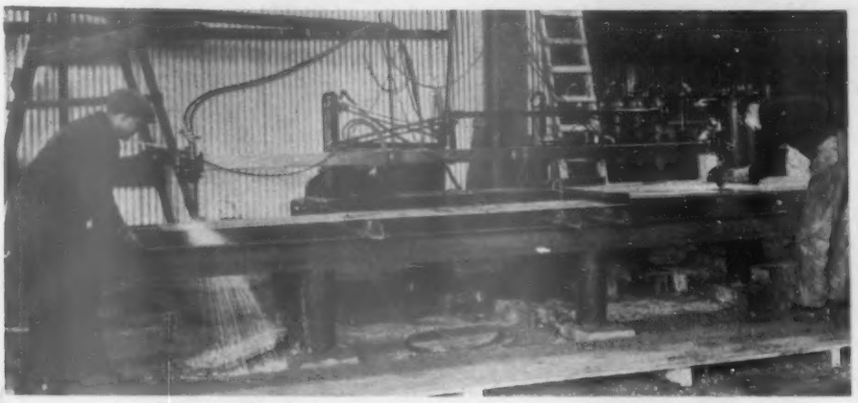
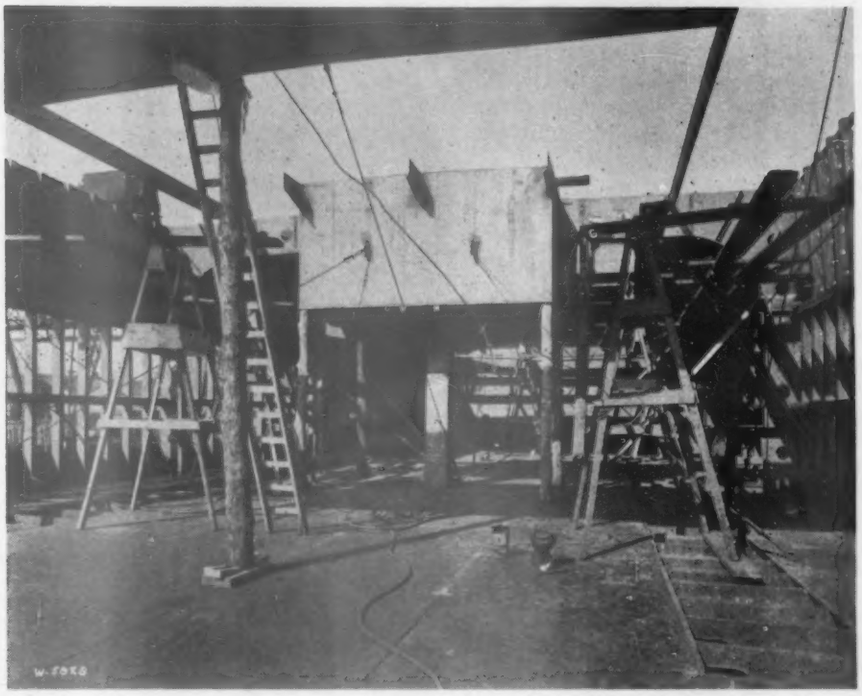
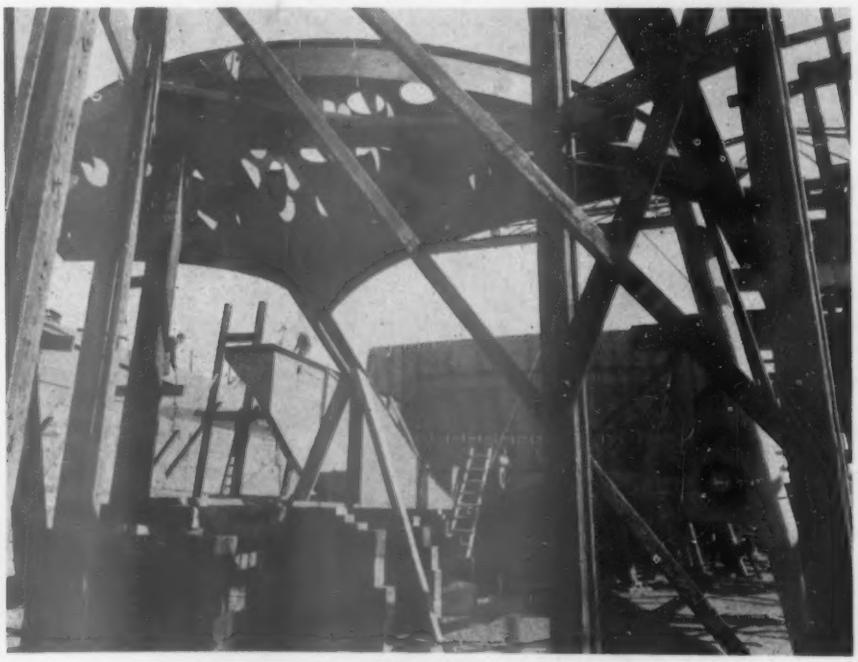


The Shape-Cutting Machine Is an Indispensable Adjunct to Shipyards.



One Strake Is Omitted From Each Side of the Tank Top Until All Piping in the Double Bottom Is in Place.



Bulkhead in Background and Transom Section in Foreground.

forward of the machinery space. Officers' quarters, ballast tank, and chain locker will be forward of the cargo holds.

The pilot house is located forward and is electrically lowered for passing under bridges. Masts and stanchions are hinged. The boat davits, ventilators and stacks are arranged for removal. Fuel oil is to be carried in wing tanks in the engine room. Each vessel is to have two rudders, and two 6x1-in. steel fenders running the length of the vessel.

Hull Sections Fabricated on Ground as Complete Units

Wherever possible, advantage was taken of fabricating sections of the hull as complete units. Sections to be preassembled and welded on the ground before erection include all floors, bulkheads, webs, sheer-strake plates welded to frames, main-deck stringers, plates welded to short beams, decks between hatches, athwartship coamings, arch plate, space bar and bracket assemblies, engine foundation and miscellaneous other foundations, skylight, transoms and cants, and such small parts of the hull structures as could be welded to the larger units.

The method of erecting the hulls is as follows: The bottom plates are used full size with their ends beveled for flush butt joints, welded from the top. The keel plates are laid on blocks lined up, and the butt joint tack welded. The center-keelson plates are erected beginning at the center of the vessel and tack welding them to the keel, while the plates are held vertical by temporary brackets on one side. The "B" and "C" strakes of the bottom plating are laid on blocks beginning at the center of the ship. The middle butt welds of the keel and center-keelson plates are then welded. The center-keelson plate is welded to the keel for the length of one plate forward and aft of the welded butt joint. An additional butt joint is welded for each plate, following which the next center-keelson plate is welded to the keel.

Floors Are Welded to Center Keelson and Bottom Shell

The floors of the vessel are erected uniformly on both sides of the ship. They are welded to the center keelson and tack welded to the bottom shell of the vessel. The longitudinal plates are fitted in place and tack welded as fast as the floors are erected. When 12 floors are welded, each side, to the center keelson, the plate for one tank top is laid each side and tack welded to the center keelson and floor. The welding of the shell and rider seams is then completed for one plate length, following which the floors are welded to the shell and tank-top plating. The first butt joints of the shell are then welded and the assembly continued.

Welding Progresses From Center of Vessel Outward

The general procedure for welding is to start at the center of the vessel, weld outward, forward and aft from this point. Erection is maintained about a day ahead of the welding. The butt welds for each plate are completed before the next plate is fixed by any seam welding. Any contraction which might occur athwartships in the bottom plating is adjusted in the lapped seams. One strake is left off the tank top at each side until all piping in the double bottom is in place and the width of the plates adjusted to suit. Any contraction longitudinally is adjusted in the last deadflat plates at each end.

The midship arch and the two midship bulkheads are erected and plumbed when the tank construction has reached the proper point. At that time, two sheer strake plates at each side, with attached frames, are erected and the frames welded to the tank top. Bilge plates are then erected and welded as rapidly as the frames are in place. The deck assembly is erected on the midship arch and the two bulkheads.

Overhead Welding Is Avoided Wherever Possible

Downhand welding is used wherever possible. However, with the transverse system of framing, the welding of tank top to floor throughout the ship and deck plating to beams in the ends must be overhead. The finish welding is started at the precise center of the vessel and progresses outward, port and starboard, and fore and aft, leaving material ahead of the welding free to move and leaving no unfinished seams or welds which might cause excessive strain or distortion when they are welded. All the welding in the construction of these two freighters is being done by the shielded-arc process.

All arc welding operators working on these two vessels were qualified according to the rules of the American Bureau of Shipping.

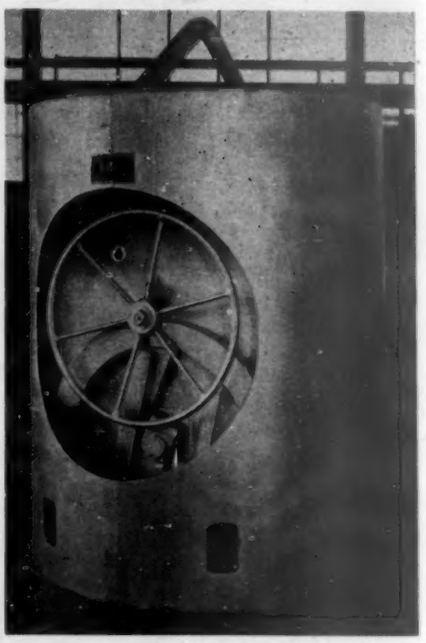
Welding Saves Weight by Eliminating Excess Metal

The increase of 300 tons in cargo-carrying capacity is made possible with arc-welded construction because of the elimination of intermediate connecting members and ability to use lighter sections in various parts of the hull frame than would be possible with riveted construction. Saving in weight results from omission of laps and butt straps and the use of rolled sections in an inverted position. For instance, the leg of the angle frames is against the shell with the stiff flange inboard, thus producing a stiffer frame for the same weight or permitting use of a lighter section.

It is quite generally conceded that the total man-hours are less on a welded hull than on a riveted hull.

Welded Design Features New-Type Concrete Bucket

An all-welded, cylindrical concrete bucket, designed particularly for convenience of operation in close forms, and for handling low slump concrete, has been designed by the Dravo Corp., Pittsburgh, Pa. The bucket is of the bottom-dump controllable type, and is now being manufactured in 2, 3 and 4-yd. capacities. It has no projecting



All-Welded Concrete Bucket.

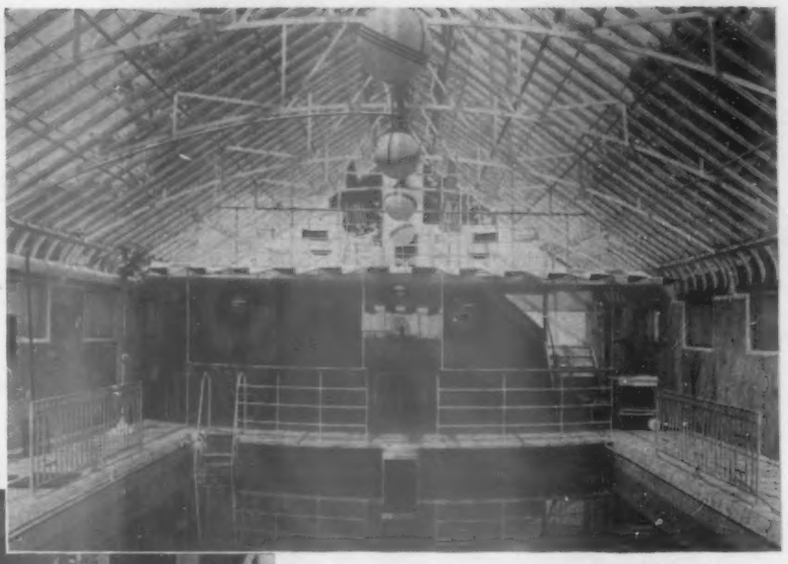
levers and is operated entirely by a hand-wheel set into the outer shell of the bucket. Two wheels are provided on the 4-yd. buckets.

In addition to facilitating the opening of the bucket in close quarters, the new welded design provides an added safety feature in that there are no projecting parts to catch on forms, reinforcing steel, or the clothing of men operating the bucket. In operation, it was found that the method of mounting the control gate was such as to make the bucket self-closing, and it can be closed readily when only a part of the concrete has been poured.

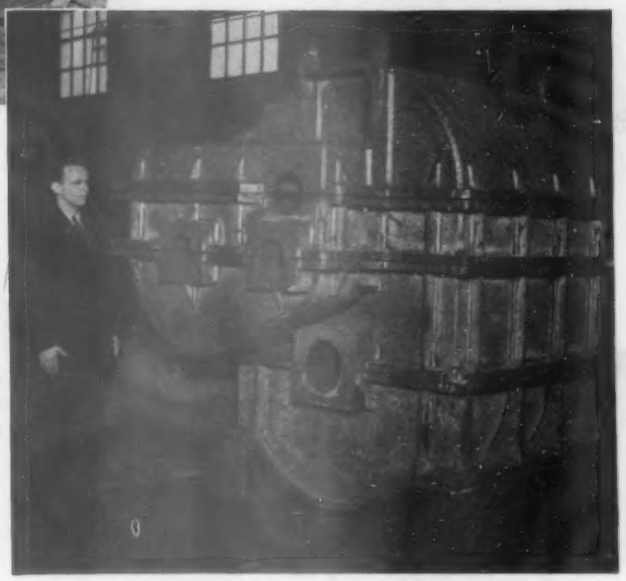
Operation of the new buckets has been found easy, and maintenance costs low, since the operating mechanism, which might become clogged with concrete, is protected by shields, and the welded construction assures a sufficiently strong machine.

Welding News in Pictures

■ *(Below) Welding joints in curb bends, ties and ells for by-pass curb sections for temporary gas mains at the Sixth Avenue Subway, Route 101, Section 7. Work being done by Craftsmen Welders, Inc., in the pipe yard of the Arthur A. Johnson Corp. and Necaro Co., New York City. Fabricated from 20-in. pipe, with butt joints reinforced at stress points with 4x4x⅜-in. plates placed diagonally across the welds.*

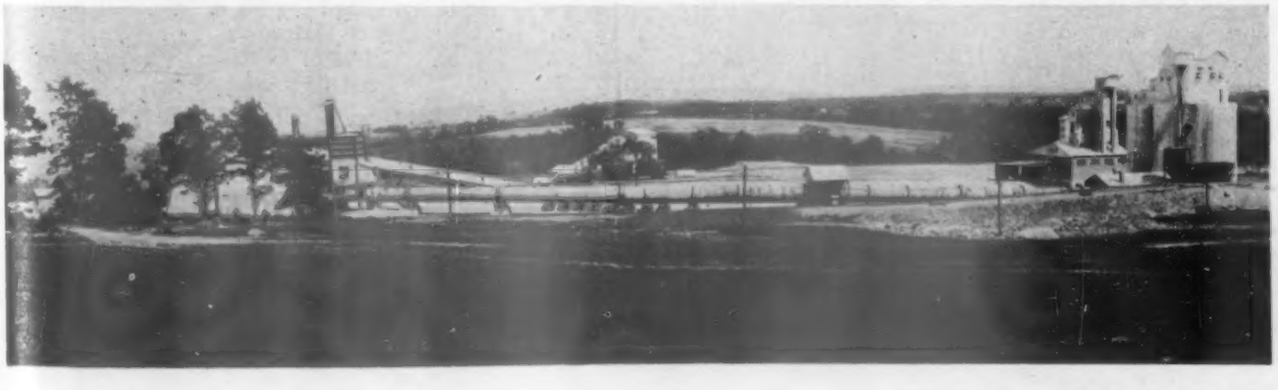


■ *Enclosed swimming pool, all arc welded. The pool itself is approximately 30x40 ft. There are three dressing rooms, a shower room, upper deck and roof garden, where one may find delightful recreation at all times of the year. An all-arc-welded steam boiler keeps the water at the desired temperature during the winter months. (Photograph courtesy of Hobart Brothers Co.)*



■ *Welded steel construction was substituted for steel castings in this drive housing for a rotary slitter fabricated in the welding shop of the Bethlehem Steel Co., Bethlehem, Pa. The cutting and welding were completed in less time than the patterns could have been made for castings, and an estimated saving of 15% to 20% in cost was effected. Plates range in thickness from ¾ to 1½ in. Both plates and forgings were used for the bearing housings, and the total weight of the four sections as shown, previous to machining, is 13,205 lb.*

■ *This rotary lime kiln, believed to be the largest in the world, is entirely arc welded. It was manufactured by the Traylor Engineering & Manufacturing Co., Allentown, Pa., and is installed at the plant of the Chemical Lime Co., Bellefonte, Pa. Total length is 400 ft., and capacity is 200 tons of lime per day. Temperature of operation varies between 400°F. at one end and 2100°F. at the other. One-inch and ⅞-in. steel plate used throughout. (Photograph courtesy The James F. Lincoln Arc Welding Foundation.)*



Welded Reinforcements *for* Concrete Structures . . .

■ By O. BONDY
Consulting Structural Engineer

CERTAIN of the principles of welding design as applied to reinforced-concrete structures were dealt with in a preceding article[1], also the welding procedure itself and various types of joints for reinforcing rods were discussed. Butt-welds were shown to be the most up-to-date type of joint, and several concrete bridges were described erected by means of butt-welded reinforcements.

In this article it is proposed to discuss applications of welded reinforcements in buildings and other reinforced-concrete structures. There is a great variety of such applications, beginning with welded wire mesh and other welded fabric, and the tack welding of binding wire and stirrups to secure them in correct position, to the all-welded reinforcements for buildings up to free spans of 282 ft.

Comparatively little is known about the applications of welding in these fields. In recent years the welding of steel structures, both buildings and bridges, proved to be much more attractive to structural engineers, while the welding of reinforcements for concrete structures was kept in the background.

A few months ago the International Association for Bridge and Structural Engineering held their Second Congress in Berlin and Munich. The Preliminary Report, consisting of more than 1,600 printed pages, contained no less than 24 papers dealing exclusively with problems and achievements in connection with welded steel structures. It is significant that not a single report has been dedicated to the subject of welding in reinforced-concrete structures. Structural engineers would probably pay more attention to the possibilities of all-welded reinforcements if they would only know more about the facts.

Structures with welded reinforcements already in service may be considered as the best proof of the reliability of the new method. A short description of some of these reinforced-concrete buildings and other structures may, therefore, encourage reinforced-concrete designers to take advantage of welding for their own purposes.

Four Advantages of Welded Concrete Reinforcement

There can be little doubt as regards these advantages for welded concrete reinforcement applied to buildings and structures of any type: (1) There is no need for hooks or overlapping of reinforcing rods. This not only means saving in weight of steel, but a still more important saving in cross-section of concrete. (2) Stock-length bars no longer impose a restriction upon the designer. He can easily weld them together just to comply with the needs of his design. Especially for wide spans it will mean a great advantage using tensile and compression bars continuous over the whole span. (3) By securing stirrups, binding wire and spirals, by tack welds, a rigid body of steel reinforcement will result which can easily be handled and transported to the site without risking any dangerous shifting. (4) By introducing welding, the whole work becomes more reliable. Even with careful inspection there has always been a danger of individual rods being concreted in at a wrong place or even being left out altogether. Sometimes, surprising facts of this sort are revealed by the application of x-ray photography to existing reinforced-concrete structures. It is to be hoped that mistakes of this sort will be avoided when using welding.

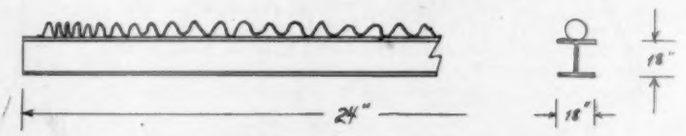


Fig. 1. "Alpha" Spiral Reinforcing Welded on Top of Steel Joist.

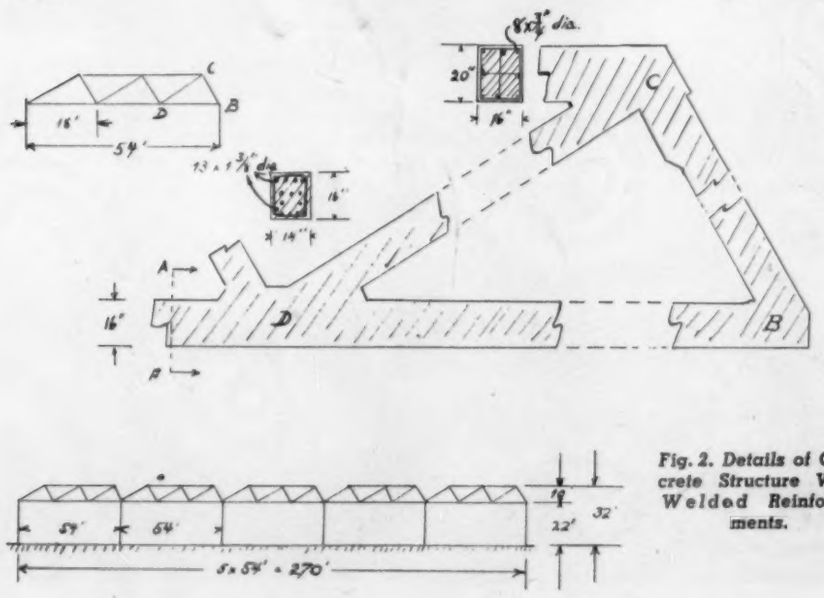


Fig. 2. Details of Concrete Structure With Welded Reinforcements.

Welded fabric has been used in recent years for a great variety of purposes, mainly for reinforced-concrete roads, floors and ceilings, and also as a reinforcement for very-thin-walled concrete roofs of cylindrical shape. When the buildings for the Ford Motor Co. factories were erected at Cologne in 1931 about half a million square feet of welded fabric was used solely for these purposes.

Welding has been used a good deal for the reinforcement of concrete floors. There are many patented designs on the market, and it appears that inventors have been quick in realizing the possibilities of welding in this field.

Spiral stirrups are often used for reinforced-concrete columns of circular or rectangular cross-section. There can be no hesitation whatever in secur-

[1] O. Bondy, *The Welding Engineer*, November, 1936.

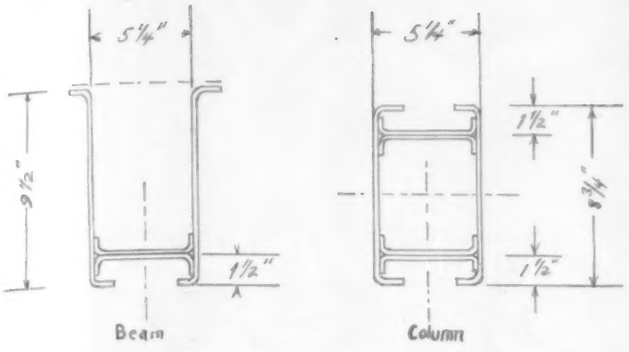


Fig. 3. Spot-Welded Sections of Pressed Steel for Concrete Beams and Columns.

ing the spiral stirrups by tack welds instead of using binding wire. Recently an interesting application of welding was made by tack welding spirals of reinforcing wire to the top flanges of floor joists or stringers of bridge decks. Fig. 1 shows one of these applications as recently carried out in the Netherlands [2]. The main advantage of this arrangement is the continuous bond between the concrete slab and the steel joist after the spiral rods have been concreted in.

Applications of Spiral Reinforcements

Spiral reinforcements and others were used for the pipe lines of the Colorado River scheme. An idea of the importance of this job is had from the fact that these pipes with welded reinforcements are about 27 miles long. In Tasmania a pier was constructed by means of 100-ft.-long concrete piles with welded spiral reinforcements. It is not even necessary to bend these reinforcements beforehand, as the heat produced by the welding arc makes it quite easy to wind them around the longitudinal bars during welding.

In New Zealand a water reservoir 84 ft. in diameter was erected by means of welded reinforcements, and it is claimed that 20% has been saved in cost. Such figures of course are not readily compared with others owing to the fact that welding for reinforced-concrete structures has rarely been done on a mass-production basis and considerable additional cost has had to be incurred. It is the more surprising that even with the early jobs of this sort a considerable saving in cost could be achieved.

For concrete railway signal posts on the lines of two English railways, reinforcements were manufactured consisting of 4 rounds as uprights with round-bar lattice work welded between them.

For the well-known Shannon Hydro-Electric Power Scheme in Ireland many of the heavy reinforcing bars were 130 ft. long, according to the design. Based on the favorable results from a series of tests, arc welding was permitted and butt welds were carried out in reinforcing rods of 1.42-in. diameter. The parent material was of 52,000-62,000 lb. per sq. in. tensile strength. The welds were not machined and showed an average strength of 53,000 lb. per sq. in., which is more than the minimum tensile strength of the parent metal. Moreover, as a precaution, the welds were arranged in a staggered position on the cranked portions.

In connection with buildings, a limited number of applications of welded reinforcements are illustrated herewith. The cross section of a paper factory erected in Wurttemberg, Germany, in 1930 is shown in Fig. 2.

Resistance Welding Used on Steel-Plate Reinforcement

So far this article has dealt only with arc welding. But there is at least one interesting application of resistance welding in the field of concrete structures. E. Mopin, the well-known French engineer, is the designer of big blocks of flats erected at Drancy near Paris in 1935. There are 1,200 flats up to 6 stories high, and 5 towers of 15 stories each and a total height of 182 ft. Cross-sections of beams and columns are shown in Fig. 3. Although corrosion-resisting steel was used, which is about 30% more expensive, a total saving of 15% in cost was claimed.

Quite recently another big scheme based on similar principles was carried out at Leeds, England. In this case the blocks comprised 900 flats. Rigid steel frames 5 stories high and of 28-ft. span were assembled in horizontal position on site and then bodily swung into the

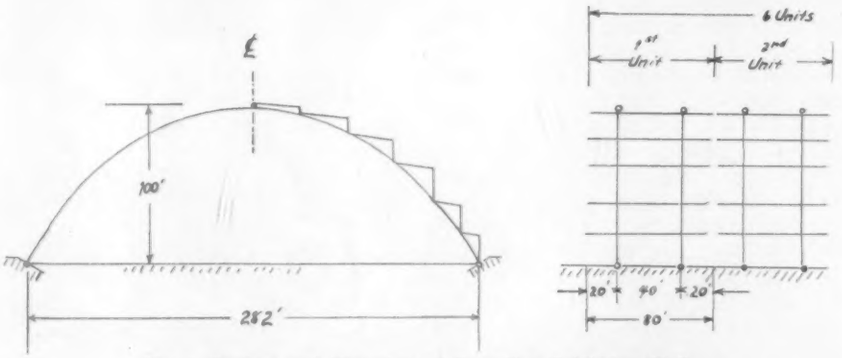


Fig. 4. Section and Elevation of Bruxelles Exhibition Hall.

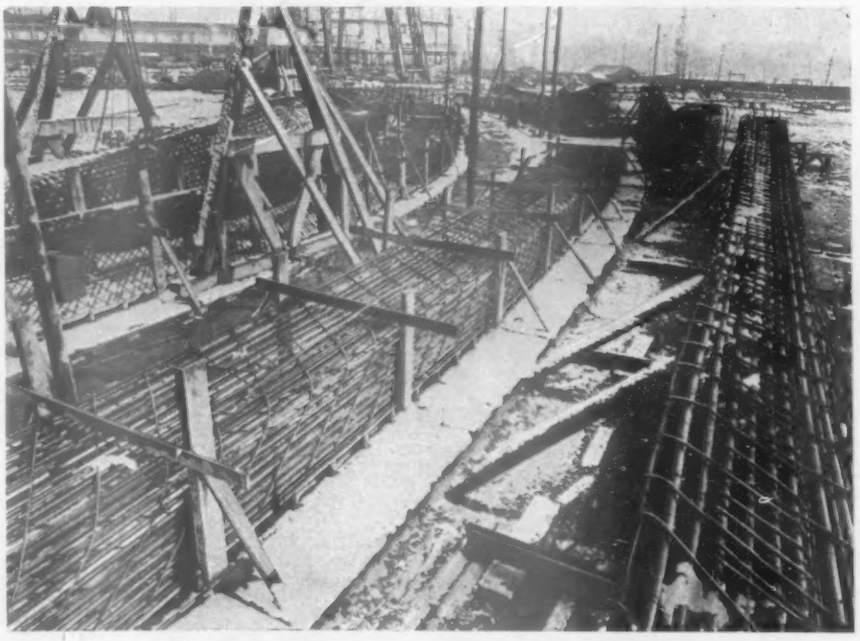


Fig. 5. Reinforcements Assembled on the Ground.

[2] Der P-Träger, Peine, April 30, 1937.

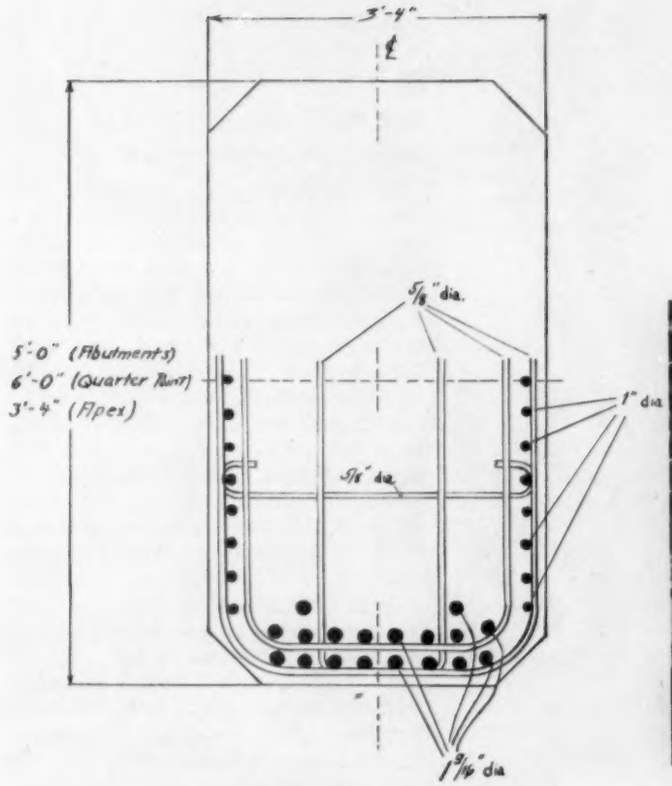


Fig. 6. Cross-Section of Concrete Arch.

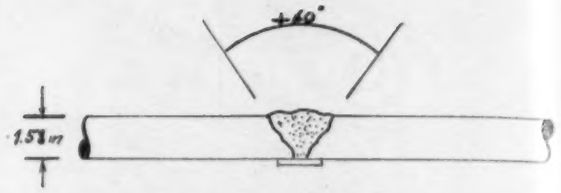


Fig. 7. Typical Single-V Butt Weld in Main Rod of 1.58 in. Diameter.

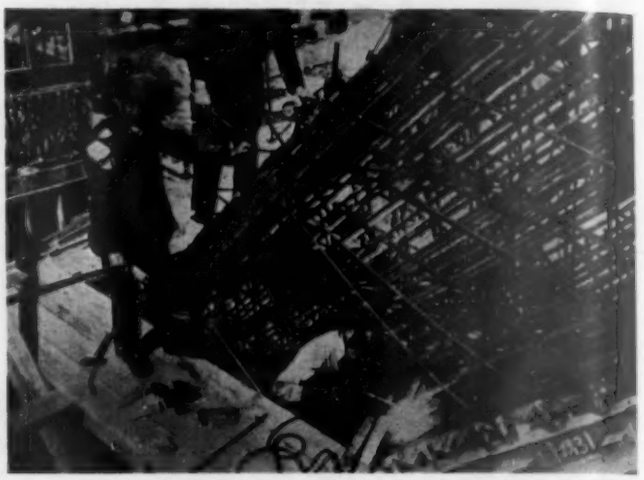


Fig. 8. Arc Welding Main Rods in Position.

vertical plane. A total of 2,800 tons of steel was used[3].

At Sydney, Australia, the so-called McMillan patent was used to secure continuity at the joints between beams and columns of a large bank building[4]. Special cleats of angle section were welded onto the reinforcements so as to facilitate transport as well as correct fitting on site. The advantages of reinforced-concrete design and rigid structural steel were thus combined.

Huge Concrete Building With Welded Reinforcements

The largest concrete building with welded reinforcements is the one erected in 1935 for the Bruxelles World Exhibition. This structure is an excellent example of the reliability of welding in reinforced-concrete structures. The main dimensions of the 12 three-hinge arches are given in Fig. 4, and the following illustrations may give still a better idea of its dimensions. No hooks or laps were used in the longitudinal bars, mainly to avoid congestion and to reduce the cross-sections to the minimum[5].

Each half rib of each arch had about 30 tons of reinforcement—that is, about 21 lb. per cu. ft. of concrete. The reinforcement was completely assembled on the ground as shown in Fig. 5. Each half rib consisted of 3 parts, each part having about 10 tons of reinforcement. The main rods were of 1.42 and 1.58 in. diameter and were assembled and fixed by arc welding. The cross-section of the arches is indicated in Fig. 6, which gives also the different depths at the abutments, quarter points and apex.

Only single-V butt welds were used for the main bars, as shown in Fig. 7. Bottom plates were used to secure sound penetration at the root. There are 1,800 welds in one arch, making a total of 21,600 butt welds for the whole building.

In a reinforcing bar of 1 3/16 in. diameter, each weld required an average of about 30 minutes, including preparation of the ends and clamping. Six or seven electrodes of 3/16 in. diameter were used for each joint, the electrodes being 18 in. long.

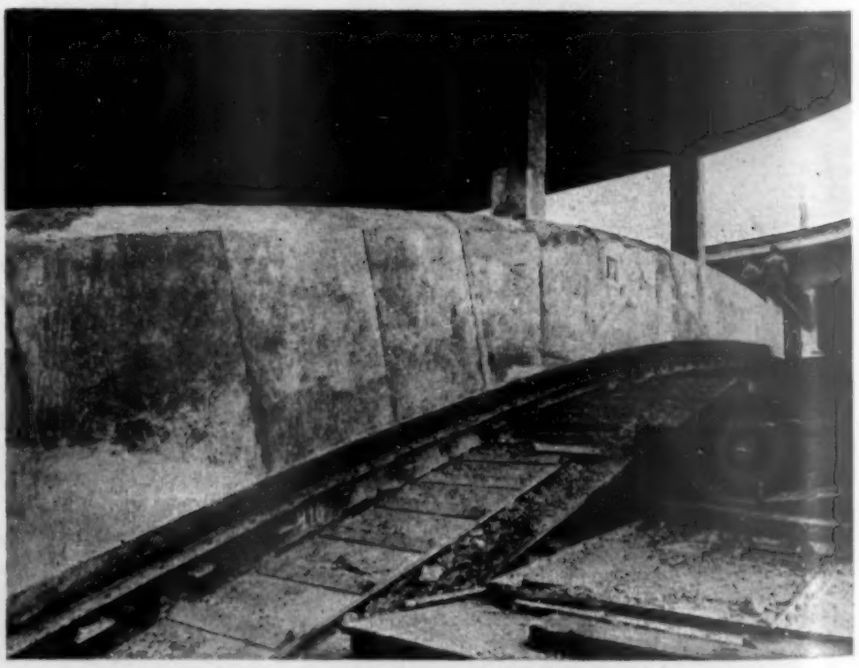
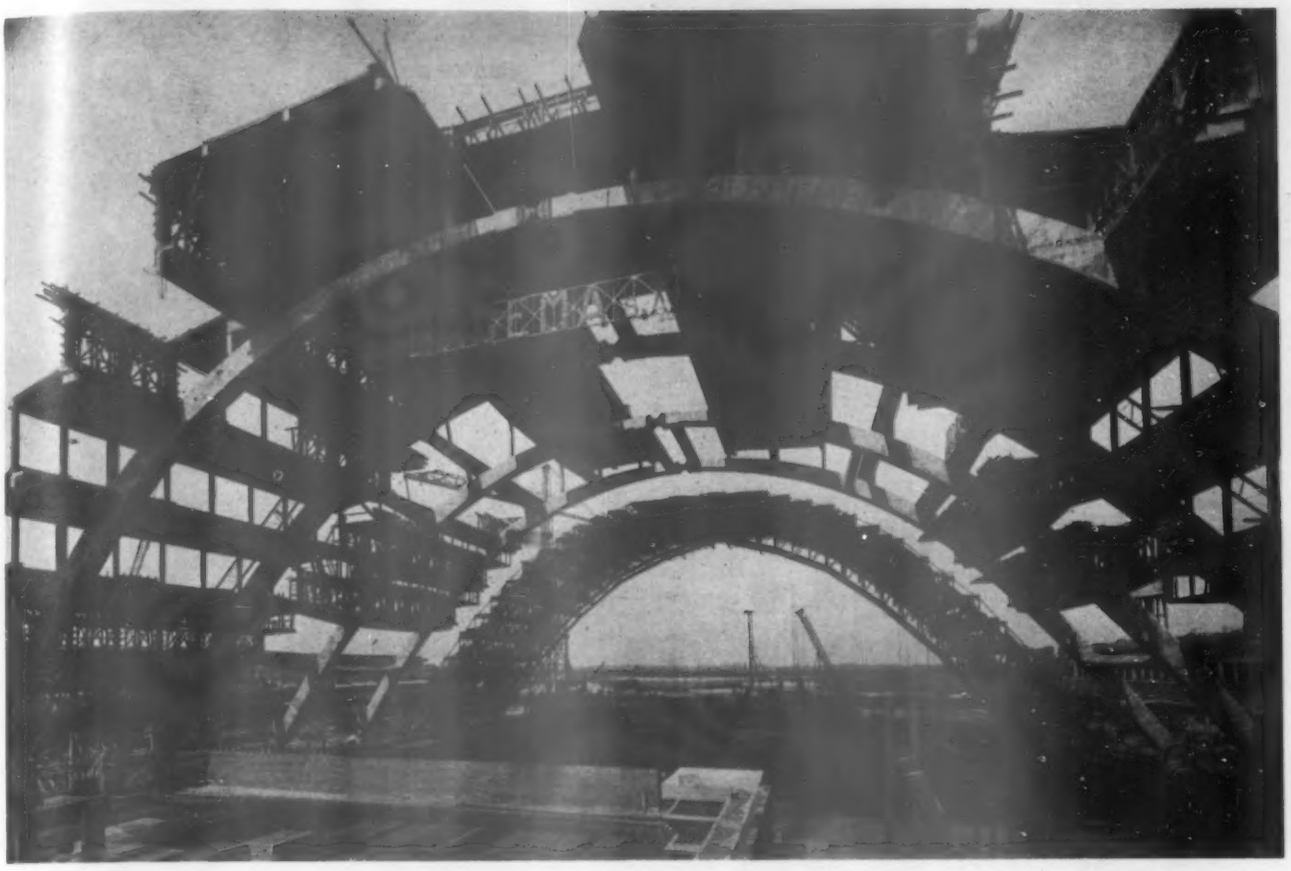


Fig. 9. Top Portion of Three-Hinge Arch After Concreting.

[3] *The Structural Engineer*, London, December, 1936.
[4] *Civil Engineering*, London, February, 1936.
[5] H. Dustin, Welding Symposium, London, 1935.



(ENGEMA S. A. and Arcos S. A., Bruxelles)

Fig. 10. View of 282-Ft. Arches of Bruxelles Exhibition Hall.

When the welding on the ground was finished, the parts of the reinforcement, each 10 tons in weight, were lifted to the form-work as shown in the illustration on the front cover. Steel centering consisting of riveted lattice arches was installed in such a way that it could be lowered after concreting and used for another portion of the same building.

The three sections of reinforcing had to be welded together in position. This was certainly not an easy task, when one considers the congestion of steel reinforcement on such a small area. Fig. 8 shows how welding was done within the form-work. One can imagine the increase in cross-section that would have been required if the ends of all main rods had to be attached by hooking and overlapping instead of butt welding.

Main Rods, Smaller Rods and Stirrups Are Welded

Apart from the 1,800 butt welds in the main bars of each arch, a great number of welded joints had to be made for the reinforcing rods of smaller diameter and for tack welding the stirrups in position. The top portion of an arch is shown in Fig. 9.

The extraordinary size of that hall is shown by Fig. 10. Each pair of arches are coupled together to form a unit. The finished building gives not only credit to its designer, being perhaps one of the largest reinforced-concrete halls constructed without intermediate support, but at the same time it shows that both the designer and the authorities were fully confident as to the reliability of arc-welded joints.

Belgian Rules Encourage Use of Welding in Concrete Structures

It is remarkable that such a great number of large welded reinforced-concrete bridges and buildings have been erected in Belgium, while designers and contractors in other countries have not availed themselves of this type of construction. It appears that the Belgian authorities, in adopting certain rules for welded reinforcements, have given much encouragement to these applications which in the meantime have proved to be so successful. In December, 1934, the Belgian Association of Standardization adopted special rules also making provision for tensile and bending tests and specifying certain requirements as regards the perfect alignment of the rods and the correct welding procedure on site. Butt welds in these reinforcements may be considered to carry 80% of the ultimate strength of the parent material if in tension, and 100% if in a compression rod.

Little provision is to be found in other regulations for reinforced concrete. Some of them do not yet allow for the reinforcements being welded. For example, the August, 1936, issue of the proposed building by-laws of the London (England) County Council contains one sentence as follows: "Reinforcement in reinforced concrete shall not be connected by welding." Fortunately, this refers only to buildings and not to other types of structures; moreover there is good prospect of having this restriction amended in favor of welding.

As compared with the welding of steel structures, the field of reinforced concrete has not yet taken full advantage of the possibilities of welding. It may be expected that both in design and procedure the welding of reinforcing rods will be improved in the future. From technical and economical standpoints the welding of reinforcements for concrete structures may lead to still better results and much more extensive applications.

Correction

The Universal Metal Welding Co., 936 E. Delavan Ave., Buffalo, N. Y., is the name of the firm that did the welding on the rotating bar in the Chez Ami in Buffalo, shown at the top of page 36 in the June issue of *The Welding Engineer*. The firm's name is not the Metal Welding Co. as stated.

Assembling Steel-Plate Work for Welding

By FOREST MAJOR
Works Manager, Tippett & Wood

The successful assembly of welded steel-plate work of various descriptions depends largely upon the careful and proper preparation of the material. Extreme care should be taken when laying out the work to allow proper clearances at the welded joints, so that unnecessary cutting, chipping and grinding are reduced to the minimum. Shearing, planing, torch cutting, etc., should also be performed very carefully and accurately in order to save time during assembly.

Steel-plate fabricators are continually complaining about the high cost of assembling welded jobs. They are forever trying to devise better and speedier methods of fitting up, when most of the difficulty is caused by careless preliminary operations, such as laying out, shearing, torch cutting, planing, bending and shaping. If these operations are accurately performed many valuable hours will be saved in assembling and welding.

Foremen sometimes severely criticize a man who is assembling a welded job, for taking too much time, when in reality the work was not laid out correctly, as well as having been carelessly cut and formed.

It goes without saying that the design of welded work is of utmost importance and is really the first step toward low cost of fabrication and good work. When the assembly man (or fitter-up, as he is sometimes called) finds it necessary to cut tack welds apart after having assembled part of a job, in order to get other pieces into position, costs mount very rapidly. Sometimes he finds it necessary to torch cut the edges of plates or shapes which cannot be taken out. This results in high costs and delays, as well as inferior workmanship in many cases.

Of course some complicated and heavy steel-plate work is more or less difficult and costly to assemble for welding, at its best. However, this is all the more reason for utmost care being taken, starting with the design and laying out and followed by careful preparatory operations for assembly.

When starting the assembly of welded work, after all parts are properly prepared, extreme care should be taken to keep center lines, openings, bolt holes, flanges, etc., in correct position. If some parts are to be welded before complete assembly, which is often necessary, expansion and contraction of welds must also be taken into consideration and proper allowances made.

As a rule butt joints are found to be the most difficult to assemble for welding; but, as stated before, if the work is accurately prepared much time will be saved, resulting in lower costs and certainly better workmanship.

In cases where it is possible to do so, it is good practice to completely assemble the job before starting to weld. There are exceptions, however, to this rule on some classes of work, as there are times when the welding must be done as assembly of the work progresses.

Therefore, most important of all, is careful and accurate preparation of the various parts of welded steel-plate work of all kinds. The best fitter-up and the best welder cannot possibly do his part of the job in a first-class manner unless the work is carefully and accurately prepared, and this important phase of the job is so often overlooked and neglected.

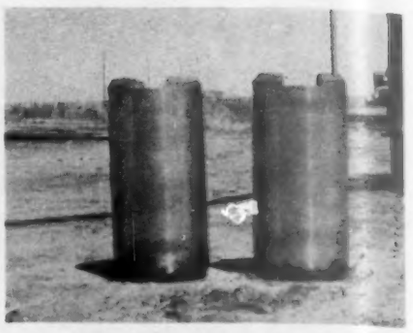
Metal Spraying of Dredge Parts

By J. S. MARTIN
Metallurgical Engineer, Metalspray Co., Inc.

Stainless steel is being extensively applied to worn wearing and bearing surfaces by the metal-spray process, and serves the dual purpose of restoring the part to size, and of providing a corrosion-resisting surface. Several grades and compositions of stainless steel are available for spraying, but most operators have standardized on two general types to cover a wide variety of applications including shafts, piston rods, sleeves, plungers, pistons, etc. These are the well-known low-carbon 18-8 steel and the medium-carbon straight-chromium-alloy containing little or no nickel. The latter is an air-hardening steel, and in the sprayed form develops a hardness of close to 400 Brinell. As a result, it is an excellent metal for use where both wear and corrosion are present.

An illustrative case is that of two 10¾-in. diameter by 21½-in.-long bearing pins metal sprayed with air-hardening stainless steel by the Pacific Coast Engineering Co., West 14th St., Oakland, Calif. These parts, of cast carbon steel, act as hinge pins for accommodating the vertical movement of the digging ladder of a large dredge, and operate continuously under water. In service they had worn undersize, and were corroded on the surface.

The metal spray procedure was essentially as follows: The pin was first machined to ⅛ in. under the finished diameter, and was then cut with a very rough 20-pitch thread 1/32 in. deep. The spray-gun unit was mounted on the tool post of the lathe, the pin revolved, and 16 lb. of stainless steel deposited to give a uniform coating of slightly less than 3/32 in. on a side. This provided ample stock for finishing by means of a tool-post grinder, and to give a finished thickness of



Bearing Pins Sprayed With Air-Hardening Stainless Steel.

1/16 in. of metal. About 2½ hour was required for the actual spraying of each item, using ⅛-in.-diameter rod, and 4 hours per piece was necessary for the finishing operation.

These sprayed pins have been in service for a year, and their performance is highly satisfactory.

Deluxe Tugboats of Welded Construction

Use of welded construction and diesel propulsion have made possible tugboats deluxe, of which the recently launched *Flushing* is an outstanding example. This tug, built by Ira S. Bushey & Sons, Brooklyn, N. Y., for the Red Star Towing & Transportation Co., New York City, is little short of palatial in many details of construction and accommodations, and presents a striking contrast indeed to the begrimed old-style tubgoat.

Numerous refinements are made possible by all-welded construction and consequent elimination of all bolts and rivets. The hull, deck, deckhouse, deck fittings, etc., have the smooth finish that results from welded construction. The welded steel deckhouse, which is painted and finished to resemble oak paneling, presents a pleasing and impressive appearance.

All fittings, stanchions, piping and vents are welded in position. The exhaust pipe is of one-piece welded construction. All oil and water piping throughout the vessel has fittings eliminated; all piping is positioned in long-radius bends to promote the ready flow of oil and water. The fuel day tank and lubricating-oil supply tank are welded to the forward upper engine-room bulkhead; both tanks possess scales that are graduated so that the engineer can ascertain at a glance the rate of engine-fuel consumption and lubricating-oil flow.

Two unsightly features that mar the appearance of the average tug are eliminated: the galley stovepipe stack, completely welded, is carried to the top and inside of the main stack, as is also the air intake head for the scavenging cylinder.

The *Flushing* is 90 ft. long, 22.6 ft. wide, with a draft of 10 ft. aft and

Views of the "Flushing" (Top) and the "Canadarago" (Bottom).

7.6 ft. forward. Propulsion is by a 2-cycle, 7-cylinder diesel, rated 735 hp. at 300 r.p.m., driving an 82x48-in. bronze propeller.

In the aft end of the upper engine room are entrances leading directly into two comfortably fitted staterooms for the engineers. Just aft of these staterooms are two crew staterooms, one on either side, containing two berths each. In all of these rooms, and also in the pilot-house and galley, the bulkheads and ceilings are insulated with rock wool, over which is laid plywood veneer with walnut or maple finish. The galley-messroom, located forward of the engine room, on the main deck, and possessing walls finished in maple with harmonizing port curtains and block rubber tile, resembles a passenger lounge in appearance. Aft of the pilot-house is a handsomely furnished double stateroom, finished in walnut, for captain and mate.

It is stated that the *Flushing* can operate continuously at full power, 24 hours a day, for 25 days, without refueling.

Another interesting example of all-welded steel tugboat construction is found in the recently launched *Canadarago*, designed for canal service, which represents the ninth all-welded, diesel-propelled tugboat that has been built at the Bushey shipyards. The tug is 76 ft. 4 in. long, with a beam of 19 ft., and is powered with a 535-hp. diesel engine. The predecessors to the *Canadarago* have amply demonstrated in actual service the staunchness, seaworthiness and dependability of welded construction under adverse and trying conditions. A tenth tugboat, similar to the *Canadarago*, is now undergoing construction at the Bushey yards.

Ohio Welding Shops Get Newspaper Publicity

An excellent example of local newspaper publicity for a job welding shop is the following, which appeared in the May 24 issue of the *Van Wert (Ohio) Bulletin*:

"Welding today is playing an important part in the business and industrial life of every community. Very often entire factories would have their wheels stilled were it not for the ingenuity of modern science to quickly repair a broken part and start these wheels humming.

"In a community like Van Wert the Central Welding Works, operated by Paul Layman at 233 S. Market St., fills an important gap.

"The Central Welding Works does electric and acetylene welding and offers a portable welding equipment of the latest type with two arc lights on it to answer calls away from the shop for repair work.

"In addition to this service, hot and cold rolled steel-bar and plate work, machine-shop work, and the building of tanks, smoke stacks, smoke pipe, and similar construction is offered by this modern establishment which has been serving this section for four years. Mr. Layman has had 15 years' experience in the welding business and knows pretty thoroughly just how to do that job, whether it's a small one or large one.

"Right now farmers will do well to check over their equipment and see if there are any weak or broken parts. Considerable money can be saved, if so, by bringing these parts to 233 S. Market St. and letting the Central Welding Works mend them again.

"The cost is small, the convenience is great, and the job will be done in a 100% fashion."

In the June 4 issue of the *East Palestine (Ohio) Leader*, an article appears in connection with the facilities of Ady's Welding Shop. The article follows:

"A very modern East Palestine concern at 524 E. Taggart St. features a complete service in welding and has gained a large patronage not only at home but throughout the surrounding territory on account of the complete and fully guaranteed service they render.

"This welding shop is fully equipped for all classes of work, including the welding of cast iron, bronze, brass and aluminum, according to the most approved process. The work is featured for the accommodation of autoists, farmers, garages and manufacturers and is a great convenience to the public.

"They have a most complete equipment and thus are prepared for the most accurate and intricate work, including the welding of machinery, as well as other forms of welding of all metals. They are experts in repairing anything in the way of broken parts. It makes no difference how little or how large they be, this firm can handle the job and complete it in a way that you will remember them next time you have anything in this line.

"The American habit of throwing away articles that are cracked or broken which for a little money can be rebuilt and made as good as new is fast passing away with the settled life of the country, and with the advent of the new era we predict for this shop a future in business that is fraught with great promise.

"They aid in keeping the wheels of industry on the move and render the trade the best of service. With the rapid development of the country their service becomes more necessary to the industries of this section.

"In making this annual business review of the onward progress of our community, we are pleased to be able to commend Ady's Welding Shop upon the efficiency and to direct our readers here when in need of the best in their line."

Get "H. O. T." on Welding

By H. O. T. RIDLON

Circulars Help Bring the Business!

Hand bills, like the one reproduced herewith, were recently put out by a welding shop, and the harvest started the first day. In fact, the first thousand circulars cost five dollars and the first job from them was a seven dollar job from the printer himself. These are printed on loud-colored paper 8½ x 11 in. During the hours and days when there are a lot of people down town these are put in cars. And many a job has come into the shop with the circular on the seat. They (the welding shop) are distributing them from house to house, because they feel that one of their biggest markets is the American home. Of course they are not forgotting their farmer friends, and they go out and call on them in their barns. Yes, sir, they find that Mr. Farmer nearly always likes to have folks drop in to say "howdee," and above all if a *profit* message is brought to him. And they tack up these circulars at crossroad gas stations where farmers gather. Then they make friends with the boys that drive the Farm Bureau trucks and give them a few circulars to carry on their trucks. Believe you me, circulars like these really pay.

* * *

It Happened One Day

It seems that perhaps this story should have been told before, because today it was called to my attention again. Frankly, I'd really forgotten the experience—but, it seems that it left an impression on the other gent and that it really carries a moral.

About two or three years ago I was breaking in a new salesman in Toledo and we called on a job welding shop. We didn't know who was the boss. But there was a gent trying to untwist an auto in the back part of the shop who made no effort to greet us. No doubt he had us spotted as peddlers and so being busy he kept right on with his work. Well, it isn't pleasing to me to be so treated, because always when I call on a shop or anyone on business I am there for a purpose and have something that they will, I believe, profit from. So we walk back and start talking to this gent. He wasn't cordial to say the least and in fact blunt.

And he was—in his opinion then—justified because we approached him about welding white metal, or die-castings, sometimes called "pot-metal." He more or less told us that we were nerts, that it couldn't be done, that he had personally tried everything on the market, and that none of these rods were worth a whoop in hell, or words to that effect. And to cap it off he was a very busy man and could not afford to spend any time on such stuff.

This was a swell challenge to me. And I wanted to know how much his time was worth an hour. His comeback was that it was worth ten dollars an hour. So I whips out a five dollar bill and says, "Mister, I'll just buy a half hour of your time, now back up and hold still. If in a half hour I haven't shown and taught you something you don't know and believe cannot be done, the five bucks is yours."

This was something that this swell gent never had pulled on him before, so he held still. We get a broken white-metal door handle, and start to work on it. We used a rod and a technique that this fellow had never tried before—a rod that has yet to let me down, and I've been welding white metal this many a year now with it. I'm not sure but I rather think that I am one of the "early birds" when it comes to using that rod. Well, I kept my five bucks and also got an order for a few pounds of white-metal rod, plus making a grand friend.

Here's the moral in this to you fellows who are on the buying end, or even the using end: You may think you have seen it all, and know all the tricks. But every now and then some guy comes along that has something that will help you a great deal and will make you much profit. And the funny part of it is that you cannot pick this guy out by looking at him. You've got to talk with him, in fact many times draw him out. For these guys that get around selling see, hear, and read a lot of things that perhaps wouldn't get to you for years, and in the mean time you are passing up a lot of good profit opportunities.

* * *

There's something about most hotels that makes one feel as lonely as a whippoorwill.

Women and cars are much alike. A good paint job covers the years—but what a story the lines tell!

H O T

The Ambassador of Better Fusion.

Do You Know that . . .

The WELD-ALL SHOP

105 N. Mulberry St., Mansfield, Ohio

Is ready to repair by WELDING any broken metal part?

That we offer to this great community a really complete WELDING service. No job too small—and if the job is too big to bring to us, we will go to the job.

THERE'S GOLD IN YOUR OWN BACK YARD! LOOK AROUND AND BRING THAT BROKEN METAL PART TO US.

WE WILL RECLAIM IT.

We Suggest for the Home—

Metal furniture, utility and ornamental objects, andirons, lamps, bookends, candlesticks, radiator covers, hinges, handles, locks, vacuum cleaners, floor polishers, cast iron stove parts, mangle cogs and cabinets, drip pans, pipe joints that leak, old pipe to be replaced in part or whole—and so on far into the night. Look from basement to attic and you'll find no end of things we can repair for you.

And don't forget the children's metal toys. We will also build special muscle and character building equipment and wading pools for your back yard.

We Suggest for Industry—

Welded pipe, broken gears, broken frames, parts that receive excessive wear can be hard-surfaced so that their life will be increased many times, rolled and cut steel plates can often replace castings. There is no end of things we can do for every industry—they will profit much by calling us!

For the Farm We Suggest—

No end of things—strong gates welded from pipe, flag poles, and earth working equipment that receives wear we can increase its life three to ten times.

Circulars Like This One Help The Welding Shop to Bring in New Business.

Farm Mathematics

OLD METHOD		OUR NEW METHOD	
New Share	$ 3.00	New Share	$ 3.00
Four resharpenings	1.40	Hardsurfacing	3.00
10 acres of plowing	4.40	30 acres of plowing	6.00
30 acres of plowing	13.20	Repointing and hardsurfacing	4.00
60 acres of plowing	26.40	60 acres of plowing	10.00

PROFIT per share for 60 acres of plowing $16.40 (on the assumption that your present shares are worn out after 10 acres of plowing). Call us and increase your plowing profits.

The WELD-ALL Shop

PHONE CANAL 2259

OXY-ACETYLENE WELDING and CUTTING — ELECTRIC ARC WELDING

HARDSURFACING SPECIALISTS — WELDING CONSULTING SERVICE

WELDING CONTRACTORS

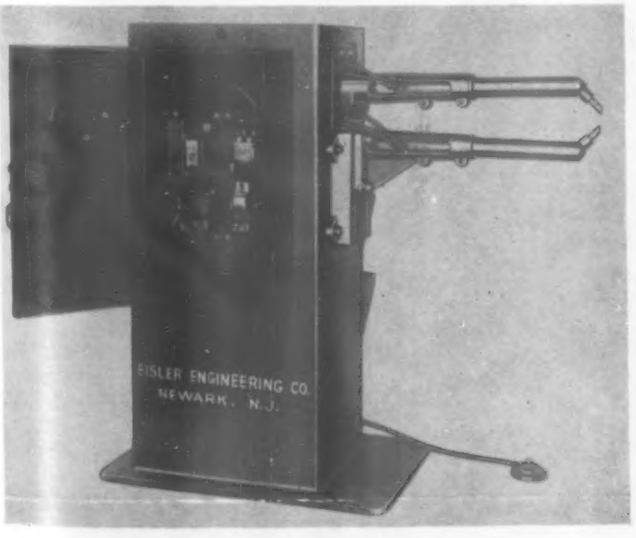
New Products

Spot Welder with Controls for Pressure and Time

One of the features of a new air-operated spot welder announced by the Eisler Engineering Co., Inc., 749 South 13th St., Newark, N. J., is that welds are controlled by means of a solenoid starter. By depressing the starter, the solenoid actuates the air cylinder, which in turn closes the electrodes upon the work. The duration of the welding period is regulated by the automatic timer and contactor, assembled on the side of the fabricated frame. The timer is adjustable to regulate the time of current flow, from 2 to 60 cycles in 110 divisions. An air-pressure valve allows regulation of the proper air pressure. This welder operates on an air pressure of 35 to 60 lb., depending on the nature of the work.

Variation in type of work is facilitated by the interchangeable arms. Arms shaped for welding different types of work can be substituted for the arms illustrated; the lower arm can also be raised or lowered to conform to the depth of work required. This welder is especially equipped with strong arm supports. These supports make possible the long arms, and, at the same time, permit the arms to slide in or out of the supports to suit the type of work being welded. A water-cooling arrangement passes water through the arms, electrode holders, and electrodes. Water is circulated very close to the ends of the electrodes. The arms on this welder are 36 in. long, arms can be supplied from 36 in. to 48 in. in length.

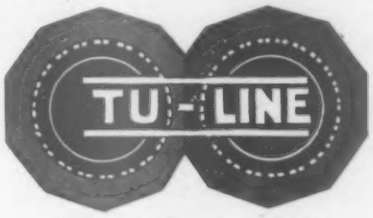
This welder is capable of making up to 100 spot welds per minute. It is equipped with an 8-point handwheel for heat regulation and has an air-cooled transformer.



Air-Operated Spot Welder.

New Type of Dual Welding Hose

The "Tu-Line" welding hose, described as a "streamline" hose, has been announced by the Quaker City Rubber Co., Frankford P. O., Philadelphia, Pa. This is a single piece of



"Tu-Line" Hose Is 10-Sided.

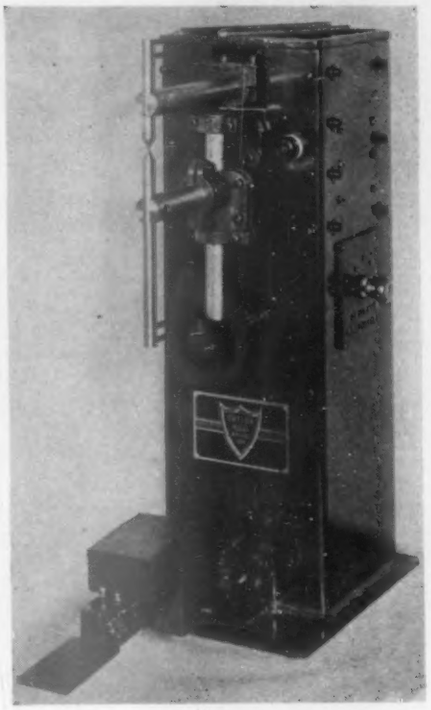
hose with two separate conduits, and is decagonal (10-sided) in section. The oxygen lane has a green cover and the acetylene a red cover. The cover is said to be soft and flexible, and will not harden or crack. The material is extra-heavy single braid, compounded of smooth non-blooming stock, moulded into one piece by a lead mould process. The hose is made in continuous lengths up to 300 ft., and in ¼-in. size.

Spot Welder With New Features

A new spot welder announced by the Taylor-Hall Welding Corp., Worcester, Mass., has the following new features:

(1) The movement of the upper electrode is in a vertical plane and not on the arc of a circle. This allows accurate and easy alignment of the electrodes, and hence two welds (up to the capacity of the machine) may be made simultaneously.

(2) The transformer and upper horn assembly are used as the pressure unit with an easily adjustable counterweight for light and medium-heavy work. This obviates the use of a spring for pressure and at the same time develops more than the usual available pressure.



New Taylor-Hall Spot Welder.

(3) The foot treadle leverage is 3½-to-1, so that even though greater pressure is available, less manual effort is necessary.

(4) A new design of rocking step plate located on the end of the treadle operates the switch. Thus the foot movement is considerably reduced and high-speed operation is possible.

(5) A turnbuckle arrangement for foot-treadle height is provided for the convenience of the operator. When flat stock without flanges is being welded, the movement of the upper electrode need only be sufficient to release the work.

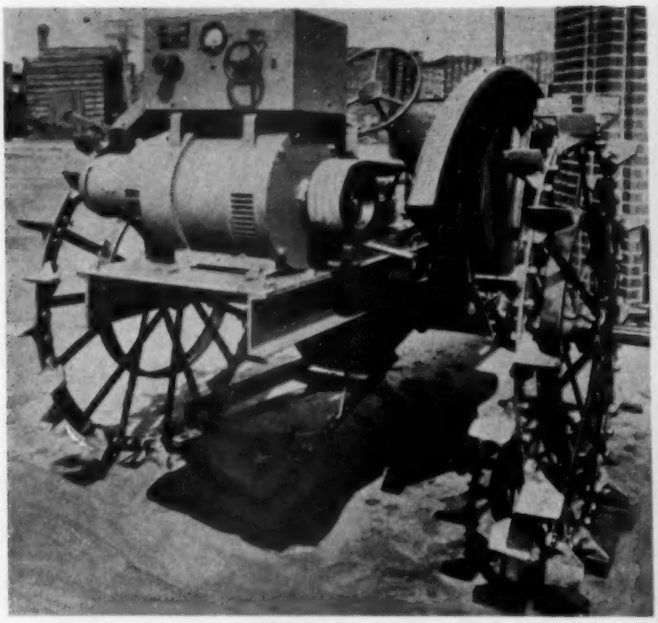
(6) Ease of operation, rigidity and long life of moving parts are assured by the use of grease-filled and sealed roller bearings front and back and long guides bearing against oil-impregnated maplewood gibs on each side.

(7) The weld is made as the foot is raised and not lowered. This eliminates pounding at high speeds.

These welders are available in sizes of 10, 17 and 25 kva. The horns and electrodes are water cooled. Pressure is adjustable from 25 to 250 lb.

Farm Tractor Becomes Arc-Welding Machine

Tractors are used for practically every farm operation and also for opening roads following heavy snow storms; pulling ditching machines through deep mud; pumping water out of basements following floods; run-



Welder Mounted on Farm Tractor.

Application of "Flexi-Weld".

ning ferris wheels; moving houses, etc. But an entirely new use of a farm tractor was demonstrated recently when the Southern California Tractor Co., of Los Angeles, fitted an arc-welding generator to a regulation size tractor. The generator is a standard model, 200-ampere unit, manufactured by The Lincoln Electric Co., Cleveland, O. The Southern California Tractor Co. is prepared to supply this type of unit in several different models and sizes.

Electrode for Flat Welding of Deep-Groove Joints

A new arc-welding electrode developed especially to produce welds of high quality in the flat welding of deep-groove joints in mild steel has been announced by The Lincoln Electric Co., Cleveland, O.

The new electrode, known as "Fleetweld 9", is said to produce weld deposits possessing high physical properties. Proper procedure with the electrode overcomes certain conditions frequently encountered in deep-groove welding which tend to cause the formation of surface holes in the metal. At the same time, the electrode has operating characteristics which assure uniformly economical performance, it is claimed.

All-weld-metal specimens of "Fleetweld 9" have high tensile properties, varying somewhat with the composition of the plate, the heat of welding, capacity of the plate and the size of the electrode used. The metal, as welded, will show a tensile strength of 66,000 to 74,000 lb. per sq. in., a yield point of 50,000 to 60,000 lb. per sq. in., and an elongation of 20% to 30% in 2 in. Stress-relieved at 1,200° F., "Fleet-9" weld-metal properties are: tensile strength, 64,000 to 72,000 lb. per sq. in.; yield point, 45,000 to 55,000 lb. per sq. in.; and elongation in 2 in., 25% to 40%. The average tensile properties of stress-relieved "Fleetweld 9" weld metal, taken from 1½-in. plate welded with ¼-in. electrodes, using 340 amperes, a.c., are: tensile strength, 68,000 lb. per sq. in.; yield point, 53,000 lb. per sq. in.; elongation in 2 in., 33%. In a free-bend test a specimen of the metal showed 78% elongation in outer fibers. Other physical properties of "Fleetweld 9" weld metal are: specific gravity, 7.85 to 7.86 grams per c.c.; impact resistance, 30 to 60 ft.-lb. (Izod); and endurance limit, 29,000 to 34,000 lb. per sq. in.

"Fleetweld 9" is designed to operate with either alternating or direct current. The electrode is made in three sizes, 3/16, ¼ and 5/16.

Portable Spot Welder Has Many Features

Electric-resistance spot welding is easily applied on awkward-shaped objects and in the most "unhandy" positions, by means of a new device known as "Flexi-Weld," developed by the American Coach & Body Co., 9503 Woodland Ave., Cleveland, O. This is a portable, adaptable equipment that enables the fabricator to weld on lighter gauges of sheet metal in practically any position.

In the manufacture of their fabricated truck bodies, the American Coach & Body Co. found they were too cumbersome to handle on stationary spot welders, and portable spot welders could not function with one electrode inside the body and the other outside. Flexi-Weld, thus originating in necessity, has proved its worth for over two years in the American plant.

Flexi-Weld has a powerful 75-kva. transformer of special design, which is hung from the ceiling on a trolley or jib crane, or it may be mounted on a hand truck. Two light-weight flexible cable leads, up to 12 ft. in length, are attached to the transformer. They terminate in separate twin electrodes weighing less than 10 lb.

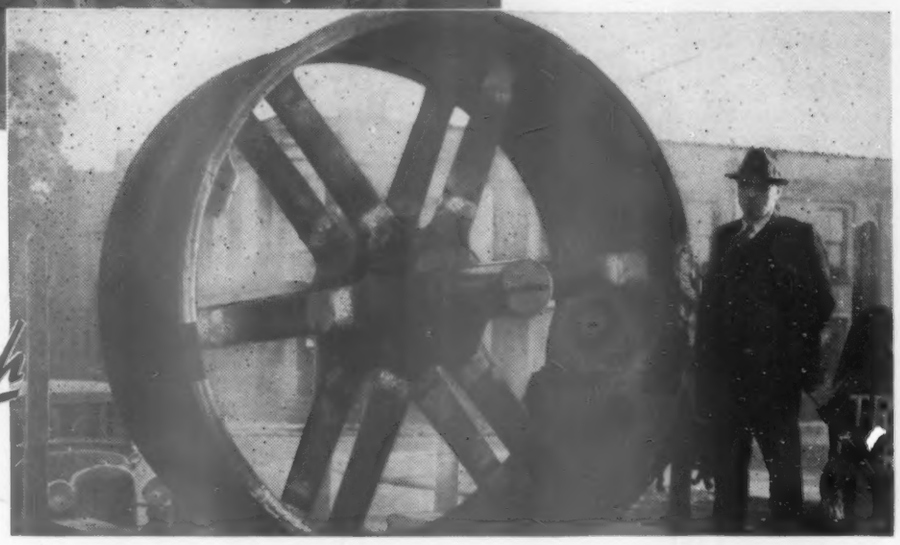
The one electrode can be clamped for "ground" to the frame work or opposed part of the structure. With the other single light-weight, flexible electrode, all welding within a radius of 6 ft. can be accomplished very quickly. Light electrodes and flexible cables enable one to weld in any position, and the inside of compartments and of channels is readily reached for welding.

Sufficient pressure must be placed on the gun before the welding current flows. The timing of the current is automatically controlled so that when sufficient current has passed through the work the contactors open and no current flows in the transformer until the next weld is made. The entire equipment is so efficiently cooled that it does not overheat in ordinary use.

As much as 50% variation in voltage can be made in 12 equal steps by changing regulator handles on the regulator mounted in the transformer housing. A high-speed magnetically operated line contactor makes and breaks both sides of the line at once, and a precision timer gives numerous

In pieces October 6th

Back on the job October 12th



THANKS TO TOBIN BRONZE!

THE whole town of Austin, Pa., depends upon this pulley for food. It turns the wheels of The Bayless Pulp & Paper Company's mill and most everybody in Austin works for Bayless.

Recently, the shaft to this 84" pulley snapped between the two sets of wheel spokes, breaking all twelve spokes away from the hub and all but three away from the rim.

The plant was paralyzed . . . delivery of a new wheel would take from four to six weeks! Some one suggested welding. The idea seemed fantastic but the Bayless Company went to Hebeler Welding Company, of Buffalo.

The pulley was rushed to Buffalo, repaired with Tobin Bronze, sent back and re-installed —all within six days. Weeks of disastrous shut-down were averted and the cost of a new casting saved.

When difficult welding jobs appear, nothing equals Tobin Bronze! This time-tried Anaconda product carries the trade-mark "Tobin Bronze Reg. U.S. Pat. Off." on each rod. Look for this mark and be sure you're getting genuine Tobin Bronze.

ANACONDA from mine to consumer 37355

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY • General Offices: Waterbury, Connecticut

Offices and Agencies in Principal Cities • In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

variations between 1/15 and 8/10 second in time of current flow.

Flexi-Weld electrode handles are interchangeable with A.C.B. guns in a few minutes. Straight, offset or angular points are interchangeable in these handles. The outfit weighs 750 lb. complete, ready for operation.

Trade Literature

A recent revision of the engineering drafting-room chart that has been put out by The Lincoln Electric Co., Cleveland, O., includes the latest weld symbols adopted by the American Welding Society. These symbols are reproduced clearly and with complete explanation in the chart. Also included are illustrations and particulars regarding the 16 types of arc-welded joints, illustrated suggestions for better welding design, sketches explaining the nomenclature of welds, a comparison of drawings for welded and riveted construction, and tabular data giving properties of base metals, weld metals, electrode metals and hard-facing, length of fillet weld to replace rivets, and safe allowable loads for fillet welds in shear. The chart is 24 in. wide and 35½ in. high, and is designed for hanging. It is suitable for blueprinting.

"A Trip Through the World's Largest Steel Mill" is a reprint of a radio program featuring Walter E. Hadley, general superintendent, Gary Works, Carnegie-Illinois Steel Corp., and John C. Baker, director, school-time program, Station WLS. In question-and-answer form, the story of steel making is told in an interesting and entertaining manner. Copies are available from the Carnegie-Illinois Steel Corp., Department of Public Relations, Chicago, Ill.

An acetylene derivative known as "Neoprene" is described in a new handbook published by the Rubber Chemicals Division, E. I. du Pont de Nemours & Co., Wilmington, Del. This is described as an engineering material with rubber-like properties, and descriptions are given of many products designed from this material. Of special interest is a summary of the method of making neoprine.

"Design" of Welded Piping" is the title of a 197-page booklet giving much valuable handbook information on the design and layout of welded connections. Subjects treated include joint design, metallurgy, standard connections, piping materials, fabrication, erection and other topics. The booklet is published by The Linde Air Products Co., 30 East 42nd St., New York, N. Y.

The Fourth edition of the "Procedure Handbook of Arc Welding" has made its appearance. The new book includes the latest weld symbols adopted by the American Welding Society and a new introduction to Part VI. Copies are available from The Lincoln Electric Co., Cleveland, O., or from The Welding Engineer, at $1.50 each.

"Splices and Tapes," published by The Okonite Co., Passaic, N. J., has appeared in a new and revised edition. Various chapters in this booklet cover such subjects as "The Importance of a Perfect Splice"; "Requirements for a Splicing Compound"; "Requirements for Adhesive Tape"; and "Instructions for Joining".

"Amsco Hard-Facing Welding Rods" is the title of bulletin 20, issued by the American Manganese Steel Co., 389 East 14th St., Chicago Heights, Ill. A number of important hard-facing applications are illustrated, and several pages of valuable suggestions are included.

Colmonoy products are described in a new catalog issued by Colmonoy, Inc., Los Nietos, Calif. Descriptions are given of applications of alloys and overlay materials, applied by the arc, gas-flame and furnace methods, also Colmonoy castings.

Braided and molded hose is covered in a new 64-page catalog published by the Electric Hose & Rubber Co., Wilmington, Del. A great deal of helpful information is included. The catalog is of the loose-leaf type and is pocket size.

The Brown Optimatic System, for measuring surface temperatures of hot bodies in motion or at rest, is described in bulletin 91-1, recently published by The Brown Instrument Co., Wayne and Roberts Aves., Philadelphia, Pa.

"Welding in Construction Work" is the title of a bulletin issued by The Lincoln Electric Co., Cleveland, O., and illustrating and describing a great variety of interesting arc-welded jobs.

"A. B. C.'s of Manganese Steel Welding" is the title of a vest-pocket-size booklet, in question-and-answer form, published by the Stulz-Sickles Co., 91 N. J. Railroad Ave., Newark, N. J.

Caterpillar tractors, road machinery and engines are illustrated on a great variety of construction jobs in a new booklet just issued by the Caterpillar Tractor Co., Peoria, Ill.

Commercial News

Graff Elected President of Ryerson Company

Everett D. Graff, first vice-president of Joseph T. Ryerson & Son, was elected president of the company at a meeting of the board of directors held on June 29. Mr. Graff has been with the company for 31 years. Edward T. Ryerson, Jr., continues as chairman of the board. W. F. Kurfess and V. H. Dieterich have been elected vice-presidents, and Ainslie Y. Sawyer is made assistant to the president. All three of these men were formerly assistant vice-presidents.

EVERETT D. GRAFF

Compressed Industrial Gases to Acquire Hollup Corp.

Acquisition of new properties, including the Hollup Corp., of Chicago, the Gas-O-Machine Products Co., of Chicago, and the Southwestern Oxygen Co., of El Paso, Tex., will be consumated with the issuance of additional stock by Compressed Industrial Gases, Inc., of Chicago, it is reported. At a stockholders' meeting of Compressed Industrial Gases on July 14, approval was given to increasing the authorized stock from 200,000 shares to 500,000 shares, and a change in the par value of the stock to $5 from no par. It is indicated from a statement by H. B. Pearson, president of Compressed Industrial Gases, that some of

Be Sure of Your WELDING!

You watch your step when you go to town — on business or to shop. You wouldn't miss a bet. You check every detail of purchases or offers.

Why not with your welding?

When trusting to chance is so unnecessary — with the country's outstanding users of welding codes, research data, Welding Journal, at your beck and call—

Yours if you belong to the American Welding Society!

Why delay?

Join the A.W.S. NOW!

Information:

Warner S. Hays, Managing Director, American Welding Society, 33 West 39th St., New York, N. Y.; your local section, or The Welding Engineer, 608 So. Dearborn St., Chicago.

the additional stock will be used if a stock dividend is declared, as contemplated, and application for listing at some future date on the New York Stock Exchange is also being considered. The Hollup Corp. are manufacturers of coated electrodes, and the Gas-O-Machine Products Co. is engaged in the manufacture of a shape-cutting machine.

National Cylinder Gas Acquires Carbo-Oxygen

The National Cylinder Gas Co., Chicago, Ill., has acquired voting control of the Carbo-Oxygen Co., of Pittsburgh, Pa., with plants in Bayonne, N. J.; Coraopolis, Pa.; Niagara Falls, N. Y.; Cleveland, O.; and Chicago, Ill.; and warehouses in Erie, Pa., and Columbus, O.

The Harnischfeger Corp., Milwaukee, Wis., announce several additions to their sales forces. Francis Leslie and U. V. Westover have been appointed sales engineers in the New York territory, and G. W. Hoskins is a new sales engineer in the Philadelphia territory. Mr. Leslie has had extensive experience with the M. W. Kellogg Co., of Jersey City, N. J., the K-G Welding & Cutting Co., of New York City, and the Superior Air Products Co., of Newark, N. J. Mr. Westover, a graduate of the General Electric School of Welding, has been connected with the National Malleable Steel Casting Co., of Toledo and Cleveland, O., and later with the Wickwire-Spencer Steel Co., of New York City. Mr. Hoskins was formerly with The Lincoln Electric Co., and has had experience as a pipeline inspector and as a tank and shipyard welder.

The Intermountain Belting & Packing Co., Denver, Colo., announces that The Lincoln Electric Co. will sponsor a 5-day course of instruction in arc-welding design and practice, to be conducted at the Cosmopolitan Hotel in Denver on Aug. 2 to 6. Instruction will be under the direction of E. W. P. Smith, consulting engineer. Mornings will be devoted, according to present plans, to a consideration of welding problems. Practical welding demonstrations will be given in the afternoons, and evening sessions will feature illustrated lectures and open discussions. This course of instruction has been given before selected groups in Pittsburgh, New York, Cleveland, Kansas City and Chicago.

The York Engineering Co., Chicago, Ill., manufacturers of welding and soldering compounds and electrode holders, have been purchased by the Chicago Welding Sales Co., 3611 W. Ogden Ave., Chicago, according to an announcement from Samuel H. Shaykin, president of the latter concern. Arthur E. York, of the York company, has joined the sales force of the Chicago Welding Sales Co., who will continue the manufacture of York products.

J. F. Lincoln, president of The Lincoln Electric Co., and director of the Lincoln Electric Co., Ltd., of London, England, is now in England giving a series of talks at the invitation of various engineering societies and institutes, including among others the South Wales and Monmouthshire Institute of Engineers, the Institute of Engineers and Shipbuilders of Scotland, and the Institute of Mechanical Engineers in London.

The E. and M. Sales Co., 3050 E. Grand Blvd., Detroit, Mich., has been reorganized by the addition of H. D. Andrea to the company. Ernest E. Brooks, formerly a partner, is no longer with the firm. R. E. Prill, formerly with a local steel corporation, has joined the staff at welding engineer. The company contemplates placing on the market shortly a new type of electrode holder.

Following his appointment as general works manager of the Taylor-Wharton Iron & Steel Co., William G. Hulbert has now been elected as vice-president of the company, succeeding the late S. M. Buck. Mr. Hulbert continues his duties in charge of the manufacturing at both the High Bridge, N. J., and the Easton, Pa., plants of the company.

The Automotive Electric Supply Co., 1907 Caroline St., Houston, Texas, have changed their name to the Acme Welding Supply Co. Howard Proctor, the owner, organized this company 6 years ago. Sales of welding equipment and supplies have so much increased that the company now devotes all its attention to the welding business.

Twenty-three professors and instructors from 21 colleges and trade schools in 16 states and Canada, extending from Massachusetts to Vancouver, attended a special course in arc-welding and practice given in Cleveland, O., under the sponsorship of The Lincoln Electric Co., during the week of June 14.

The Haynes Stellite Co. has announced plans for the construction of a new building at its plant in Kokomo, Ind. Plans call for a 2-story fireproof building, 132 ft. long and 44 ft. wide. The present office building is to be remodeled into a recreation center.

H. F. Boe, Eastern district manager of the Westinghouse Electric & Manufacturing Co., has taken on added duties as commercial manager of the company, and will direct the commercial activities of the apparatus division.

The Linde Air Products Co. announces that work will start immediately in South Chicago, Ill., on the construction of an oxygen plant, to be located on Harbor Avenue adjacent to the Calumet River.

Norman J. Quinlan, formerly superintendent of production and processing contracts, has been appointed assistant to the general superintendent of the Gary Works of the Carnegie-Illinois Steel Corp.

Ryerson a dependable source for Welding Rod

● Ryerson Engineers have developed a series of rods that are outstanding for Quality production. More than twenty types, including both electric and gas rods, are carried in stock. Whether you need a shielded arc type for production work or a stainless steel rod you can be sure of immediate shipment... *Write for Bulletin which gives complete data.*

Ryerson
Shielded Arc Type No. 215
Shielded Arc Type No. 216
Shielded Arc Type No. 217
Green Processed No. 18
Copper Coated No. 206
Copper Coated No. 210
Cast Iron

ELECTRODES

Ryerson
Green Processed No. 6
Bare Mild Steel
Brown Processed
White Flux Coated
High Carbon White Flux Coated
Blue Flux Coated

GAS RODS
3½% Nickel Steel
High Carbon Bare No. 2110

Ryerson
3½% Nickel Steel Flux Coated
High Manganese Steel Hard Surfacing
Allegheny Stainless Flux Coated
Allegheny Stainless No. 44
Tobin Bronze
Allegheny Stainless Bare Hard Filler

JOSEPH T. RYERSON & SON, Inc., Chicago, Milwaukee, St. Louis, Detroit, Cleveland, Cincinnati, Buffalo, Boston, Philadelphia, Jersey City

The L. B. Allen Co., Inc., 6719 Bryn Mawr Ave., Chicago, Ill., have taken over the management of the Standard Flux Manufacturing Co., of Chicago. S. S. Crippen, Jr., will conduct the business.

The Gil V. Dye Co. has moved from Dallas, Texas, to 1903 Caroline St., Houston, where complete factory warehouse stocks of welding equipment and supplies will be carried.

The Hercules Products Co., 325 Roebling St., Brooklyn, N. Y., have been appointed distributors for "Cast Iron Paste", a flux used in the welding of castings.

Notes From the Field

An Iowa farmer went to a tractor company in Des Moines, Iowa, to buy a combine and he wanted it with rubber tires, like those on his tractor. The company didn't want to lose the sale, so tractor rims and tires were placed on the combine, the spokes of the combine wheels having been cut to fit the tractor rims and welded to them. Thus was the sale made, to the satisfaction of all concerned. This story was recently related by W. R. Jones, of the Western Tool & Stamping Co., 712 Park St., Des Moines, who also tells about a job done on a cast-iron punch press that was broken at the bearing of the ram. A steel bearing was made and studded to the cast iron above, and the bolts used for studs were cut about 1 in. below, and then the two pieces were welded.

Increase not only in the quantity of work which his shop is able to handle, but in the size of the jobs which can be undertaken, has been obtained by Milton Bowers of the Milton Bowers' Welding Co., Memphis, Tenn., recently by an addition to his shop which doubles the working area. The increase comes on the heels of one of the biggest years the shop has had since it was established in 1931. A considerable amount of the recent work has been that required in the construction of the new Firestone Tire & Rubber Co. plant at Memphis, such work including construction of framework for interior installations, erection of a carrier frame for an overhead monorail system, and special tools for the assembly lines.

An interesting and successful operation of torch cutting in muddy water was performed at Lock No. 26 on the Ohio River, near Gallipolis, O., according to U. S. Engineers in charge of the Huntington district. Beartrap valve shafts measuring more than 3 in. in diameter were removed by this method. The work, in charge of Diver Howard F. Graham, was done from the deck of a derrick boat. The cutting torch was equipped with a housing around the tip, through which a 65-lb. jet of air displaced the water from around the cutting flame. The time required to cut each of the four shafts was about 30 minutes. The cutting was performed in 10 ft. of water.

The welding of the dipper teeth on a steam shovel owned by the Shook & Fletcher Ore Co. was a recent job handled expertly by Mr. H. C. Hardwick, welder for the Birmingham Welding Co., 2312 1st Ave. S., Birmingham, Ala. Most of this concern's bigger jobs come from the mines in and around Birmingham, and at one time or another Mr. Hardwick has been contacted for such jobs in over a dozen counties in the state where these mines are located. Another job lately completed by this company was the welding of framework and a large tank, a part of the air-conditioning equipment for the Pizitz Department Store of Birmingham.

A Titan* rod is available for every bronze welding purpose:

Penn Bronze—is a general purpose rod. It is low melting (1620° F.) and tins easily and uniformly on galvanized, cast, malleable or wrought iron as well as steel, brass, bronze and any other non-leaded metal with a melting point above 1850° F. It makes tough high-strength welds of high ductility, immune to strain hardening and with great abrasion and corrosion resistance.

Titan Manganese Bronze—is used where both hard and tough welds are desired. Although this is a general purpose rod, it is especially recommended for cast iron. It is free flowing and gives extremely dense, non-porous welds.

Titan Bronze—is a tin bronze with uses and characteristics similar to the manganese alloy; penetrates seams and crevices readily.

Double deoxidation—an exclusive feature found only in Titan Welding Alloys—provides protection against the formation of gases and oxides in bronze welding. Thus you are assured of welds that possess definitely greater strength and ductility.

If you haven't tried these Titan Welding Alloys, you are invited to send for samples. Test them, and prove the difference to your own satisfaction. Descriptive literature on request.

*U. S. Patent No. 2,022,439

Titan Metal Manufacturing Co.
Bellefonte, Pennsylvania

J. C. Sharrock, head of the welding department and part owner of the Holden & Sharrock Machine & Welding Co., 118 South 21st St., Birmingham, Ala., announced that, although having been in business only eighteen months, work had increased rapidly. Recent welding jobs include work on a huge filter for the Cloverleaf Butter & Fat Co., of Homewood, Ala.; machine and welding work on several government trucks owned by the local Resettlement project; and labor on large fans for the Bethune Electrical Co. Also, a special-built 16-gauge stainless-steel tank was constructed for the Homewood Dairy.

The Crafte Weld Engineering Co. was recently organized in Detroit, Mich., by Russell J. Wolfe, Fred R. Perry, and Ivar T. Wedin, who are all experienced men in the welding field. The company will do general engineering on welding production and fixtures, and will be affiliated with an undisclosed welding shop which will do the detailed work. The company also plans to manufacture a spot welder. Offices are maintained at 817 Ford Building, Detroit, which a small shop or laboratory is being established in Ferndale, north-end suburb, at 22747 Woodward Ave.

David Adame, worker in an orange by-products plant at Chino, Calif., owes his life to the timely use of an oxyacetylene cutting torch. Standing over five tons of orange pulp in an open tank, the worker slipped and plunged into the vat of pulp and was buried in the slimy mass. An alarm was given, and as a welder was nearby, his cutting torch was quickly brought into use. Cutting out a hole in the side of the steel vat, the limp body of the victim was removed. He was quickly revived by an inhalator squad.

The Connecticut Quarry, New Britain, Conn., recently removed two 85-in. gears from a stone crusher which had been welded 8 years ago by Charles Nicholas, owner of the Hardware City Welding Co., 41 Pleasant St., New Britain, as they were too worn for further service. The job 8 years ago received the welding of 3 spokes in one year and 5 in the other, all broken through the rim. For advertising purposes, Mr. Nicholas drives an ancient Essex coach which he delights in saying is as old as himself.

In the making of their utility trailer axles, Trade Auto, of Queens Village, N. Y., weld both spindles where they join the end of the axle, top and bottom, to eliminate any play. Then the tie rods are cut, the wheels aligned properly, and the tie rods welded to the axle. This concern is also making a narrow trailer axle by cutting out about 8 in. from the center of the axle and shortening the tie rod, then welding both in the same manner as described above.

The National Shipping Co., of Cleveland, O., has awarded a contract to the Dravo Corp., of Pittsburgh, for two all-welded steel towboats. Assembly of the first of these has started in the Neville Island yards of the builder. These towboats will be used to haul coal from the mines in the Pittsburgh district to a river-rail terminal for distribution to interior parts. They will be of the stern-wheel type, each 145 ft. long, 32 ft. wide and 6.4 ft. deep.

Joseph Chesnas, owner and manager of the Chesnas Commercial Body Builders, welding concern of Waterbury, Conn., reports that his business in building commercial bodies for trucking and other businesses is flourishing. Mr. Chesnas also takes in a large number of cracked gasoline pumps, which, by welding, he restores to a "good as new" condition. Many local concerns are replacing worn-out truck bodies with new Chesnas bodies.

The American Bridge Co., Pittsburgh, Pa., reports progress on three all-welded steel dump scows, each with 280 cu. yd. capacity, for the U. S.

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Engineers at St. Louis, Mo. These scows are costing $53,820. The same firm is also building an oil barge, 145 ft. by 26 ft. by 7 ft. 4 in., of all-welded steel construction, 150,000 gallons capacity, for the Standard Oil Co. of Ohio, Cleveland, O.

Some new safety features and other improvements in welded steel homes are being perfected by H. M. Harwood, of Los Angeles, Calif. A home is soon to be built in Los Angeles in which will be incorporated, among other things, ramps instead of stairs, a "sit-down" shower (no particulars available) and late developments in dining-car galleys and modern kitchen designs.

The United Aircraft Welders of America, an affiliate of the United Automobile Workers of America, has asked that the Wages and Hours Bill pending in Congress specify a 25-hour week for welders engaged in work on government aircraft contracts, basing their argument on the claim that the average working life of a welder on aircraft construction is less than 12 years.

The Dravo Corp., of Pittsburgh, Pa., has completed the last of a fleet of 25 steel welded barges which have just been delivered to the Wheeling Steel Corp. for use in the coal trade in the Pittsburgh harbor. The barges will be used to haul coal from the Wheeling Steel mines on the Allegheny River to the large plant of the corporation t Steubenville, Ohio.

Apex Welding & Erecting Co. has been formed, with a plant at 2025 Butternut St., Detroit, Mich., to engage in welding and steel structural work of all kinds, largely for industrial and manufacturing plants. J. F. Esperon, the head of the company, was for a number of years a mechanical engineer and construction engineer in New York City.

A fleet of 25 box cars, requiring welding in their assembly, is being built in the Oneonta, N. Y., car shops of the Delaware & Hudson Railroad. The method of construction used is the "spot" system, in which the underframe, sides, ends and roofs are constructed separately and then assembled to form the completed car.

Sam Farmer, of Pasadena, Calif., who for many years has been connected with the Standard Machine & Auto Works, recently acquired equipment and has opened a job-welding shop of his own at 687 S. Broadway, in Pasadena. The shop will be conducted under the name of Sam's Welding Service.

W. G. Smith recently took over the management of the Williamson Welding Works (branch shop) at 1126 E. Colorado St., in Pasadena, Calif. Mr. Smith will specialize in welding car bumpers, fenders and starter teeth. He states that he is arranging to advertise his service over a local radio station.

The West Oak Gasoline Co. has awarded a contract for welding a 14-mile, 10-in. gas line in the vicinity of Sayre, Okla., to the Frenchies Welding Works. The stovepipe method of construction, and oxyacetylene welding, will be employed, says a report from The Linde Air Products Co., New York, N. Y.

A contract for arc welding 44 miles of 10-in. and 12-in. pipeline from the Rio Vista Field to Dawson, Dixon and Napa Junction, Calif., and 12 miles of 8-in. line from Davis and Woodland, Calif., has been awarded the H. C. Price Co., San Francisco, Calif., by the Pacific Gas & Electric Co.

The Aluminum Co. of America has begun work on a manufacturing plant in Los Angeles, situated at Fruitland Road and Magnolia Avenue. Many

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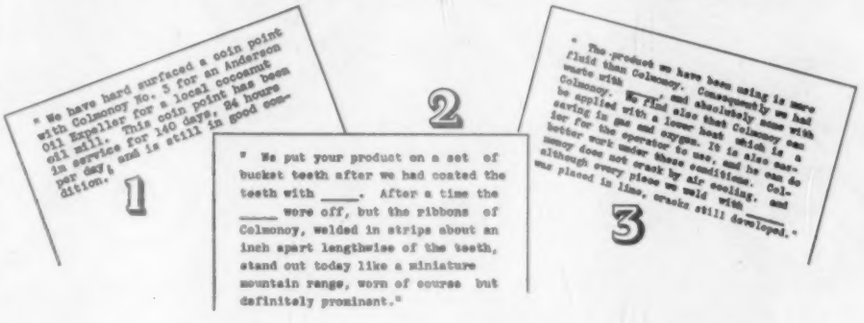
" We have hard surfaced a coin point with Colmonoy No. 5 for an Anderson Oil mill. This coin point has been in service for 140 days, 24 hours per day, and is still in good condition.
1
" We put your product on a set of bucket teeth after we had coated the teeth with ____. After a time the ____ wore off, but the ribbons of Colmonoy, welded in strips about an inch apart lengthwise of the teeth, stand out today like a miniature mountain range, worn of course but definitely prominant."
2
" The product we have been using is more fluid than Colmonoy. Consequently we had waste with ____. Consequently we had Colmonoy. We find also that Colmonoy can be applied with a lower heat which is a saving in gas and oxygen. It is also easier for the operator to use, and he can do better work under these conditions. Colmonoy does not crack by air cooling. Colmonoy does not crack by air cooling. Although every piece we weld with ____ was placed in line, cracks still developed."
3

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welders will be among the 300 men to be given employment in the new plant, the cost of which is said will be approximately $570,000.

A welded pipeline will soon be installed in the Wilmington (Calif.) oil field to gather and transport to storage the rapidly developing production of that field. Many producers are cooperating in the installation.

J. F. Gilaspie, who manufactures small welded boilers at the Capital City Boiler Works, 300 E. Court Ave., Des Moines, Iowa, reports that he has received Underwriters' approval on two small welded boilers for pressures suitable for cleaners and pressers.

The South Side Welding School, 731 West 70th St., Chicago, Ill., has taken over the Midwest Welding School located at 450 East 61st St., including all the assets. The students enrolled in the latter school will complete their courses in the South Side Welding School.

Two welded steel fuel flats are being built by the Dravo Corp., of Pittsburgh, at its Neville Island yards, for the Union Barge Line Corp. One of these flats will be 110 ft. long, 24 ft. wide and 9 ft. deep and the other 80 ft. long, 18 ft. wide and 6 ft. deep.

Completing a program which required much welding, the Skelly Oil Co. is finishing the construction of the fourth natural-gasoline plant in the dolomite trend area, in Hutchins County, Texas. The plant is near Skellytown.

A great deal of welded piping as well as other welded installations will go into a new $200,000 cold-storage plant at Sixth and Jackson Sts., in Phoenix, Ariz., for the Arizona Citrus Growers Association.

The Hydraulic Supply Mfg. Co., Seattle, Wash., using welding extensively in the fabrication of its products, will soon build a 32 x100-ft. addition to its steel-fabricating plant at 7500 8th St. South.

Clint Hadley, owner of the Peru Welding & Manufacturing Co., Peru, Ind., has moved into his new shop building at 1009 Peoria St., which is 75x100 ft. in size and is equipped for all modern machine and welding work.

"Welding Standards" was the subject of a talk by Leon C. Bibber, welding engineer, Carnegie-Illinois Steel Corp., Pittsburgh, Pa., at the June 21 meeting of the Kansas City Section, American Welding Society.

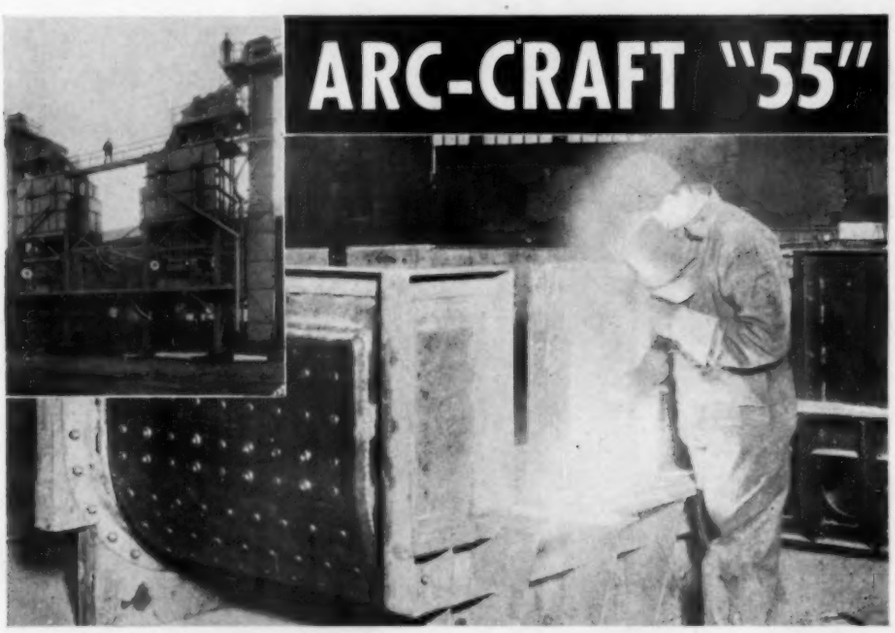
Many welders will be added to the force of the Lockheed Aircraft Corp., Los Angeles, Calif., upon completion of two new additions to the plant located at Victory Place and Empire Avenue.

Tom Frost recently opened a welding shop on the highway near Eugene, Ore. Mr. Frost was formerly located in Riverton, Wyo., where he operated a shop and did much oil-field welding.

John Horace Keefe, 45 years old, owner of the Imperial Welding Works at 525 S. Wichita St., Wichita, Kan., died on June 3 in a hospital in Sulphur, Okla.

A welding shop will be included in the manual-arts building soon to be erected by the Huntington Beach High School, Huntington Beach, Calif.

Burglars recently broke into the welding shop of C. H. Jensen, El Monte, Calif., and escaped with about $300 worth of welding equipment.



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